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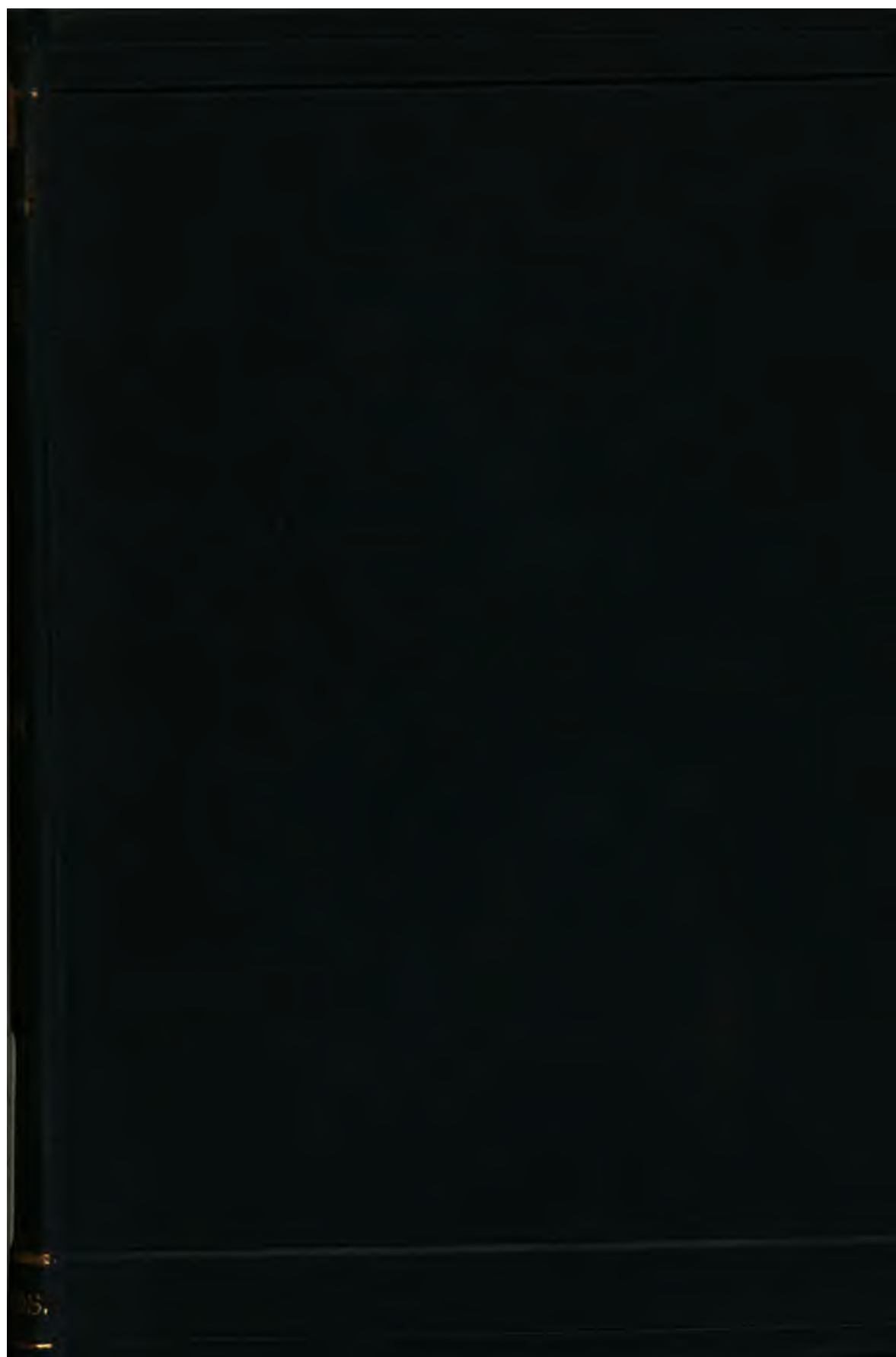
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**THE HEREFORD EARTHQUAKE
OF 1896**

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THE

HEREFORD EARTHQUAKE

OF DECEMBER 17, 1896

BY

CHARLES DAVISON, Sc.D., F.G.S.

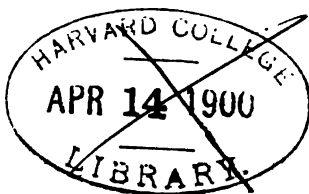
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PREFACE

IN the introductory chapter I have endeavoured to express my obligations to the numerous ladies and gentlemen who by their courtesy have rendered possible the investigation of an important earthquake, and by many a kindly gleam of sympathy have lightened a heavy labour.

A work like the present appeals to but few scientific men, and to a still smaller proportion of general readers, and my best thanks are therefore due to the Council of the Royal Society for a generous gift from their Publication Fund, without which the book could not have been printed. To a Committee of the same Society I am also indebted for a grant from the Government Research Fund, from which the expenses of investigating the earthquake were defrayed.

It is difficult for me to express adequately my thanks to Professor Lapworth without appearing to use the language of exaggeration. Every geologist will recognise his touch in the final chapter ; but I feel also that whatever of pleasure there is in the pursuit of my life, and whatever of value there may be in the fruits of it, are largely owing to the bracing influence of his friendship.

CHARLES DAVISON.

BIRMINGHAM.



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PART I
RECORD OF OBSERVATIONS

CHAPTER I

INTRODUCTION

THE most important seismic district in these islands is the well-known village of Comrie in Perthshire, situated close to the great fault which forms the southern boundary of the Scottish Highlands. The northern boundary of the same region is another prominent fault, at different points of which, but especially in the neighbourhoods of Ben Nevis and Inverness, earthquakes are far from uncommon. Within the last forty years, rather severe shocks have also originated in Pembroke-shire and Essex, in or near the west of Yorkshire, and in the district with which this work is more immediately connected, the south-east of Herefordshire.

Of all these districts, the last is the most favourable from a seismological point of view. It is not interrupted by great arms of the sea in the very places where it is most important to have a large number of detailed observations. The counties of Brecon and Radnor, lying immediately to the west, are indeed mountainous and rather thinly peopled, but, with these exceptions, the central area is one over which villages and country houses are closely and uniformly distributed, it is crossed in all directions by a network of railway lines, and at no great distance from the origin are several large towns containing numerous capable and intelligent observers.

Again, while the earthquake of 1896 was strong enough to be interesting, it was not too severe for accurate study. Those who felt the shock were able to bestow their full attention upon it, and many of the narratives which follow bear witness to the closeness of observation and the freedom from exaggeration of my correspondents.

The time at which the earthquake occurred (shortly after half-past five in the morning) was in one respect unfortunate, for a large number of the observers were asleep when it began. As a rule, however, they were easily awakened, and so lost only the earlier part of the sound-vibrations. The advent of Christmas may have delayed the writing of many accounts, but, on the other hand, it was the

means of uniting witnesses from different parts of the country under one roof. It is therefore without exaggeration that I say that conditions so favourable, and observations relatively so numerous, have rarely, if ever, fallen to the lot of any seismologist.

Collection of Evidence.—Having felt the shock myself, I was able to begin the work of collecting evidence without delay. My first step was to seek the co-operation of the newspaper press, and within five days letters asking for information were sent to all the more important papers published in the country, the total number being about 400. How many of these letters were inserted I have no means of knowing, but the number must have been very large, and I should like to take this opportunity of tendering my best thanks to the editors of these journals for the great help which they have given in my attempt to investigate the earthquake.

Not a few newspapers added largely to our knowledge of the shock by the admirable reports which appeared in their columns. The information they contain is of course not always reliable. Many letters were meant to be amusing, and others exhibit defective observation on the part of their authors; but to a seismologist the exaggerations are obvious, and the errors are as a rule, I believe, easily detected. When these accounts are eliminated, there is left a large residue, valuable from a scientific, and interesting from a local point of view. Though a good deal of repetition naturally occurs in different journals, some idea of the amount of information collected in them will be obtained from the statement that my series of newspaper reports, if continuously extended, would form a column 200 yards in length.¹

As soon as my letters to the newspapers were finished, I began to make my usual inquiries, first in the counties immediately surrounding the epicentre and afterwards in those more remote. For the towns and larger villages, my letters were directed whenever possible to well-known scientific men residing in them. For the country districts, I relied almost entirely upon the help of the clergy, and it is a pleasant duty to acknowledge the debt which I owe to their keen powers of observation, as well as to their courtesy and the kindly interest they have taken in the work. To them, and to all the ladies and gentlemen who have assisted me by recording their experiences, I beg to offer my sincere and very hearty thanks.

I endeavoured also to secure the assistance of various public bodies

¹ Among the papers which have contributed most to our local knowledge, I may mention the *Birmingham Daily Gazette*, *Birmingham Daily Post*, *Bristol Observer*, *Western Daily Press* (Bristol), *South Wales Daily News* (Cardiff), *Western Mail* (Cardiff), *Gloucestershire Echo* (Cheltenham), *Hereford Journal*, *Hereford Times*, *Leicester Chronicle*, *Liverpool Courier*, *Liverpool Daily Post*, *Northampton Herald*, *Oswestry and Border Counties Advertiser*, *Western Morning News* (Plymouth), *Sheffield Daily Telegraph*, *Staffordshire Advertiser* (Stafford), *Worcester Herald*, *Worcester Journal*, and *Worcestershire Chronicle* (Worcester).

in collecting the necessary materials, and I have gratefully to acknowledge the ready courtesy with which in several cases my request was granted. By the order of the Elder Brethren, copies of my printed questions were sent to the chief keepers of the lighthouses on the English coast. Mr. C. S. Dennis and Mr. J. Galt, the general managers of the Cambrian Railway and the Brecon and Merthyr Railway, forwarded my papers to the stationmasters in the service of their respective companies, and increased my debt to them by further collecting and returning to me the answers. Mr. J. L. Wilkinson, the general manager of the Great Western Railway, gave me a most useful introduction to the stationmasters employed by that company. From the signalmen and other officials on the above lines, I received many good determinations of the time of occurrence.

Through the kindness of the officers, my request for information was communicated to the members of most of our leading provincial scientific societies. Mr. G. R. Griffith, the Secretary of the Chester Society of Natural Science, and Mr. H. Wilkins, the Secretary of the Nottingham Naturalists' Society, forwarded a copy of my questions to every member of these societies, and in this way about 800 forms were distributed. In other cases, copies were laid upon the table at the societies' meetings, and were afterwards filled in and forwarded to me by some of the members present. I have not always been able to identify the papers thus returned to me, but I beg to thank Mr. C. B. Holdsworth and Mr. J. W. Bodger for the valuable accounts which they sent from the members of the Bradford Scientific Association and the Peterborough Natural History Society. The records from the county of Essex are necessarily few in number, but they would have been still more scanty had it not been for the notice which Mr. W. Cole inserted in that ideal journal of a provincial society, the *Essex Naturalist*.

The results of the inquiries made through the medium of scientific societies have, I must confess, been somewhat disappointing, both to myself and to the gentlemen who have endeavoured to aid my work at so liberal an expenditure of their own time and labour. It is difficult to account for this except on the supposition that our provincial societies are largely maintained from a sense of duty or local patriotism rather than from a direct personal interest felt by the members in their work. I should add that it is in quantity only, not in quality, that the records thus obtained are deficient.

I am also indebted to several other gentlemen, who, acting in a more or less private capacity, have rendered most timely and welcome assistance in securing records of the earthquake. Mr. H. Cecil Moore, of Hereford, has been unwearied in making inquiries among the members of the Woolhope Naturalists' Field Club, of which at the time he was President, and among his friends and patients. Much of the information given below with reference to the damage to buildings in and

near Hereford is due to his careful investigations. Mr. E. Greenly, F.G.S., formerly of H.M. Geological Survey, and now residing at Achnasheen, near Bangor, has laid me under a great debt, not only for the numerous records which he has so willingly collected from the counties of Anglesey and Carnarvon, but also for the valuable note which he has contributed to this work on the relations between the geological structure of the ground and the nature and intensity of the shock. In the work of collecting evidence, he has, he informs me, been assisted by Miss Grace Ellis and Mr. Ivor Pryce, to whom my thanks are also due. Prof. Grenville A. J. Cole, F.G.S., of the Royal College of Science, Dublin, at once took steps to secure the preservation of records of the shock in Ireland. He wrote on my behalf to the principal papers published in the capital, and afterwards presented me with a series of valuable letters obtained in reply to them. Our knowledge of the earthquake as it affected the sister island is largely, almost entirely, owing to the very thoughtful and kindly interest which he has taken in the subject.

Several accounts of the earthquake have appeared in scientific journals, and the authors of these have generously allowed me to make use of their materials. Mr. G. J. Symons, F.R.S.,¹ forwarded some letters and a collection of newspaper cuttings. Mr. H. G. Fordham² and Mr. J. Lomas, F.G.S.,³ lent me their series of records from Hertfordshire and the adjoining counties in the one case, and chiefly from the neighbourhood of Liverpool in the other.

To many other gentlemen I am greatly obliged for a number of very valuable accounts of the earthquake collected from the districts in which they reside. Especially I may mention the names of Mr. W. Heward Bell, F.G.S., of Holt (near Trowbridge), Mr. H. Arnold Bemrose, F.G.S., of Derby, Mr. W. A. Capron of Hartlebury, Mr. J. M. Clements of Rhoswirl (near Chirk), Mr. E. S. Cobbold, F.G.S., of Church Stretton, Dr. J. Dougall of Welburn Grange (near York), Rev. S. N. Harrison, of Ramsey (Isle of Man), Dr. Wheelton Hind, F.G.S., of Stoke-on-Trent, Mr. E. Howarth, F.R.A.S., of Sheffield, Prof. C. Lloyd Morgan, F.G.S., of Bristol, Mr. H. Ormerod of Westbury-upon-Trym, Mr. W. Pearce of Pershore, and Mr. J. G. R. Powell of Malvern. Mr. J. G. Wood has furnished me with several accounts from Herefordshire and other places. Lastly, Prof. J. Milne, F.R.S., the well-known seismologist, transferred to me a collection of letters which he received about the minor shocks before and after the principal earthquake.

¹ "The Earthquake of December 17th, 1896," *Meteor. Mag.* vol. 31, 1897, pp. 177-185.

² "The Earthquake of the 17th of December, 1896, as it affected the County of Hertford," *Hertfordshire Nat. Hist. Soc. Trans.* vol. 9, 1897, pp. 183-208.

³ "The Earthquake of December 17th, 1896," *Liverpool Geol. Soc. Proc.* 1897, up. 91-98.

List of Questions.—The following is the list of questions enclosed in my circular-letter. I give it in full, partly to illustrate my method of investigation, partly because reference to it will permit considerable abbreviation in the narratives recorded in the next chapter. I should mention that the question 4 (*g*), on the apparent direction of the movement, does not appear in the original form. It is inserted here because I received much information on this point. Though the observations are individually of little seismological value, it will be seen in a later chapter that collectively they are not altogether without interest.

1. *Name of the Place* where the shock was felt.
2. *Situation of the Observer.*—(*a*) Whether indoors (and on which floor of the house) or in open air. (*b*) How occupied at the moment of the shock.
3. *Time* at which the shock was felt, if possible to the nearest minute.
4. *Nature of the Shock.*—(*a*) Was any tremulous motion felt before the principal vibrations¹ and for how many seconds? (*b*) How many principal or prominent vibrations were felt, and for how many seconds did they last? (*c*) Was any tremulous motion felt after the principal vibrations, and for how many seconds? (*d*) Did the movement gradually increase in intensity and then die away, or were there two or more maxima of intensity or series of vibrations; and, if so, what was the interval between them and the order of their intensity?² (*e*) Were the principal vibrations strongest near the beginning, the middle, or the end of the series? (*f*) Was any vertical motion perceptible, and, if so, was the movement first upward and then downward, or *vice versa*? (*g*) What was the apparent direction of the movement?
5. *Duration of the Shock* in seconds, not including that of the accompanying sound.
6. *Intensity of the Shock.*—Was it strong enough: (*a*) To make windows, doors, fire-irons, etc., rattle? (*b*) To cause the chair or bed on which the observer was resting to be perceptibly raised or moved? (*c*) To make chandeliers, pictures, etc., swing, or to stop clocks? (*d*) To overthrow ornaments, vases, etc., or cause plaster to fall from the ceilings? (*e*) To throw down chimneys, or make cracks in the walls of buildings?
7. *Sound phenomena.*—(*a*) Was any unusual rumbling sound heard at the time of the shock, and, if so, what did it resemble? (*b*) Did the beginning of the sound precede, coincide with, or follow, the beginning of the shock, and by how many seconds? (*c*) Did the end of

¹ In the "Notes" accompanying my circular-letter, it is suggested that "the tremulous motion may be taken as that during which it is not possible to distinguish the separate vibrations or to-and-fro movements; the principal vibrations, when it is possible to do so."

² In the observations recorded in chap. ii., the answer "yes" refers to the first part of this question.

the sound precede, coincide with, or follow, the end of the shock, and by how many seconds? (d) Did the sound become gradually louder and then die away? (e) Did the instant when the sound was loudest precede, coincide with, or follow, the instant when the vibrations were strongest, and by how many seconds? (f) Did the sound change in character at or about the time when the vibrations were strongest?

With one exception, my letters to the newspapers contained only the more important of the above questions, namely, those numbered 1, 3, 5, 6, and 7 *a, b, c*. Question 4 was replaced by the following: "(a) What was the nature of the shock? (b) Did the shock consist of two distinct parts, separated by an interval of a few seconds? (c) If so, which part was the stronger, and how long was the interval between the two parts?" My object in providing this simpler series of questions was of course to elicit information from observers untrained and unacquainted with scientific methods. From a long experience, I know that the testimony so obtained may be of considerable value.

Summary of Accounts.—The total number of useful replies that I have received in answer to my letters in the newspapers and to my circulars is about 2100, rather more than half being in answer to the former. The number of accounts contained in the next chapter is 2902. These come from 1940 different places, their distribution according to counties, etc., being shown in the following Table.

[TABLE.

TABLE I
NUMBER AND DISTRIBUTION OF PLACES OF OBSERVATION

County.	Abbrevia- tion.	No. of Places.	No. of Accounts.	County.	Abbrevia- tion.	No. of Places.	No. of Accounts.
Hereford . .	H	147	209	Huntingdon . .	Hu	7	8
Gloucester . .	Gc	154	246	Cambridge . .	Ca	8	10
Worcester . .	Wc	120	202	Essex	E	13	14
Shropshire . .	Sh	91	120	Suffolk	Sf	2	4
Radnor	R	26	34	Norfolk	Nf	4	6
Brecon	B	24	28	Northampton . .	Nh	38	52
Monmouth . .	M	68	94	Leicester	Lc	49	63
Somerset . . .	S	63	91	Rutland	Ru	11	13
Wiltshire . . .	Wi	54	70	Lincoln	Li	25	31
Berkshire . . .	Bk	43	56	Nottingham . . .	Nt	19	40
Oxford	Ox	36	56	Derby	Dr	27	45
Warwick	W	55	90	York	Y	59	102
Birmingham, etc.	Bir	11	114	Northumberland .	Nm	1	1
Stafford	St	61	94	Westmoreland . .	Wm	2	2
Cheshire	Ch	53	79	Lancashire	L	59	98
Flint	F	16	18	Anglesey	A	10	12
Denbigh	Dn	21	26	Carnarvon	Cn	22	39
Montgomery . .	Mo	35	53	Merioneth	Me	18	20
Glamorgan . . .	Gm	50	79	Cardigan	Cd	20	23
Cornwall	C	6	7	Pembroke	P	8	9
Devon	D	51	79	Carmarthen	Cm	21	24
Dorset	Do	27	33	Isle of Man	IM	10	11
Hampshire . . .	Ha	25	40	Dublin	Db	4	5
Isle of Wight . .	IW	6	6	Wicklow	Wk	11	15
Sussex	Ss	10	10	Wexford	Wx	4	4
Surrey	Sr	41	52	Antrim	An	1	1
Kent	K	8	9	Cavan	Cv	1	1
London, etc. . .	Lon	58	86	Meath	Mh	1	1
Middlesex	Mi	17	27	Kilkenny	Kk	1	1
Hertford	Hf	48	63	Kildare	Kd	1	1
Bedford	Bd	16	22				
Buckingham . . .	Bu	45	53	Total		1943	2902

CHAPTER II

RECORD OF OBSERVATIONS: PRINCIPAL EARTHQUAKE

IN grouping the observations, the county has generally been adopted as the unit, and in each county the places are arranged alphabetically, with the exception of Hereford, which it seemed desirable to consider first on account of the important damage done to buildings in that city. The Table at the end of Chapter I. (p. 9) shows the order in which the counties are taken, and it will be seen that this is roughly a spiral one starting from the central county, Hereford.

In order to avoid the repetition of terms, I have given the narratives as far as possible under the form of answers to my printed questions (pp. 7-8), the figures and letters in thick type referring to the numbers and parts of these questions. Occasionally it is found convenient to depart from this arrangement, and in one or two cases of unusual interest the observations are described at greater length. Remarks or inferences of my own are inserted within square brackets.

The name of the observer or of my authority for any statement is always quoted, with the exception of those ladies and gentlemen who expressed a wish to remain anonymous, and of a few whose signatures I have been unable to decipher.¹ An asterisk (*) following a name indicates that the observer was awake at the beginning of the shock, and a dagger (†) that he was roused from sleep by the shock or the preliminary sound-vibrations. When neither sign is added, I have no information on this point, or the observer himself was doubtful. In the latter cases, it may, I think, be assumed that he was partially aroused by the first of the two parts of the shock, and was only fully awakened by the second.

For all places in England and Wales, the time of occurrence of the shock is referred to Greenwich mean time. In Ireland, the standard is Dublin mean time, which is twenty-five minutes behind the former. An asterisk following the recorded time denotes that special reliance

¹ In some cases, owing to want of information, I regret that I am unable to give the proper prefix to the name of my authority.

may be placed on its accuracy. I have considered it unnecessary to affix the letters "A.M." in every case to the estimates of the time.

Estimates of the duration of an unexpected and unusual phenomenon are, as is well known, almost always in excess of their true value. I endeavoured to check this tendency to exaggeration by suggesting in my circular-letter that the shock should be mentally repeated, the beginning and end being marked, and the interval timed by an assistant. My suggestion was carried out in some cases, and these, though they may not be the only ones, are indicated by an asterisk.

The intensity of the shock is referred to an arbitrary scale, known as the Rossi-Forel scale of seismic intensity,¹ of which a translation is given below. It will be noticed that, under each degree of the scale, several tests are included. So far as I know, the inventors of the scale have made no definite attempt to prove the equivalence of the corresponding tests. This is, of course, of the greatest importance, and therefore, in order to avoid error, I have almost invariably made use of one test only for each degree, namely, that which is indicated by italics. The Rossi-Forel scale is admittedly a rough one, but, in my opinion, it is difficult to over-estimate its value and the service which it has rendered to seismology.

ROSSI-FOREL SCALE OF SEISMIC INTENSITY

1. Recorded by a single seismograph, or by some seismographs of the same pattern, but not by several seismographs of different kinds; the shock felt by an experienced observer.
2. Recorded by seismographs of different kinds; felt by a small number of persons at rest.
3. Felt by several persons at rest; strong enough for the duration or the direction to be appreciable.
4. Felt by persons in motion; *disturbance of movable objects, doors, windows; cracking of ceilings.*
5. Felt generally by every one; *disturbance of furniture and beds; ringing of some bells.*
6. General awaking of those asleep; general ringing of bells; *oscillation of chandeliers, stopping of clocks; visible disturbance of trees and shrubs. Some startled persons leave their dwellings.*
7. *Overthrow of movable objects, fall of plaster, ringing of church bells, general panic, without damage to buildings.*
8. *Fall of chimneys, cracks in the walls of buildings.*
9. Partial or total destruction of some buildings.
10. Great disasters, ruins, disturbance of strata, fissures in the earth's crust, rock-falls from mountains.

¹ *Bullettino del Vulcanismo Italiano*, anno iv. (1877), pp. 39-40; *Archives des Sciences phys. et nat.* 3^{me} pér. t. xi. pp. 148-149.

LIST OF ABBREVIATIONS

<i>ab.</i>	about	<i>mid.</i>	middle
<i>acc.</i>	accompanied	<i>oba.</i>	observer
<i>app.</i>	apparently	<i>p.</i>	preceded
<i>beg.</i>	beginning	<i>pr.</i>	probably
<i>bet.</i>	between	<i>secs.</i>	seconds
<i>c.</i>	coincided	<i>sh.</i>	shock
<i>c. by.</i>	communicated by	<i>so.</i>	sound
<i>decr.</i>	decreased	<i>trem. mot.</i>	tremulous motion
<i>eq.</i>	earthquake	<i>vert. mot.</i>	vertical motion
<i>f.</i>	followed	<i>vibr.</i>	vibration
<i>grad.</i>	gradually	<i>wh.</i>	which
<i>imm.</i>	immediately	<i>></i>	greater than
<i>incr.</i>	increased	<i>></i>	not greater than
<i>int.</i>	intensity	<i><</i>	less than
<i>maz.</i>	maximum or maxima	<i><</i>	not less than

HEREFORDSHIRE

1. *Hereford*.—For the following summary of damage done to buildings in this city I am indebted chiefly to the letters which Mr. H. Cecil Moore has been kind enough to send me,¹ supplemented in some cases by information given in the three Hereford newspapers—the *Times*, the *Journal*, and the *Mercury*.

At the Cathedral the damage was comparatively slight. Inside, "a fragment of one of the stones of a lofty arch forty feet high in the south transept fell on to the floor. The pinnacles at each of the four angles of the central tower previously exhibited signs of decay, but upon examination no evidence of any damage by the earthquake was found," except a slight shaking near the apex of the south-west pinnacle. The finial of a pinnacle of the Lady Chapel was also thrown down. "All the three pinnacles at the western front testify to more or less disturbance. Mr. R. Clarke, ecclesiastical sculptor, who examined them from the lead roofing of the nave, calculates that they have been shifted $1\frac{1}{2}$ to $1\frac{3}{4}$ inches." "These pinnacles," Mr. Moore adds, "are within thirty yards of the top windows of my house [in Broad Street]. I have inspected them with my binocular. In my opinion, the central pinnacle is slightly rotated the way of the rotation of the hands of a watch, one to two inches. The northern pinnacle is still less slightly rotated in the contrary direction, only half an inch. The southern pinnacle appears to have undergone no rotation at all, but simply to have been horizontally disturbed. A mason (Mr. Maddy) who works for Mr. Clarke, and who some twelve years ago

¹ The passages within inverted commas are quotations from Mr. Moore's letters.

repaired the caps of these pinnacles, and who has been on the leads over the nave and has more closely examined the pinnacles, holds the opinion that all three pinnacles are rotated in the same direction, i.e. the course of the hands of a watch." According to a diagram, which Mr. Moore has kindly sent me, it would appear that the fractures are all horizontal, about five feet from the apex in the central pinnacle, and about three feet from the apex in the two others.¹

The spire of St. Martin's Church, which had already suffered during the gale of March 24, 1895, was cracked right through about twelve feet from the apex, the upper portion being shifted bodily out of place. Mr. J. Hartree, one of the firm of architects entrusted with the repair of the church, informs me that three pinnacles were also cracked right through, and the upper portions shifted to one side. A small finial of one of the pinnacles at the east end of St. Nicholas' Church fell, as well as a portion of a pinnacle on St. Peter's Church.

At the Workhouse the damage occurred at the back and front of the building, the sides being unharmed. Two chimney-stacks crashed through the roof, while others were twisted. One of the chimneys on the roof of the infirmary was hurled some distance. The interior of the buildings was cracked more or less in places. A large number of bricks fell down the chimney into the men's infirmary. In the main body of the house, over the able-bodied men's landing, there was a large rent in the wall.

At Barr's Court Railway Station all the seven chimney-stacks were shattered, one over the left-luggage office falling to the ground. Two stacks of the goods' office were also damaged.

The total amount of damage to buildings in Hereford is, I believe, unknown, but it must have been considerable. Mr. Moore has collected a great deal of information on this subject from builders in the city, especially with regard to damaged chimneys. Writing to me on February 9, 1897, he says: "I have already records from builders of about 140 chimneys having been repaired. I have no doubt now that more than 200 have suffered." Many of these were twisted. According to a mason, "who has already [9th February] repaired 36 chimneys, and has about a dozen more on hand, there is no rule whatever followed in rotation of chimney-stacks. They are twisted in every direction."

Professor Milne's seismic survey of Tokio² has prepared us for considerable variations of earthquake intensity within a small area, and Mr. Moore mentions some curious instances of this kind. "In the glass, china, and earthenware establishment of Mr. Cooper, only

¹ Since the above was written, a paper by Messrs. H. Cecil Moore, R. Clarke, and A. Watkins has appeared in the *Transactions* of the Woolhope Naturalists' Field Club. This paper contains a diagram by Mr. Clarke in which the directions of rotation of all three pinnacles, as well as of the pinnacle of the Lady Chapel, are represented as contrary to that of the hands of a watch.

² *Japan Seismol. Soc. Trans.* vol. x. 1887, pp. 1-36.

three houses distant from Mr. King's substantial lofty building whose chimneys were damaged, only one vase fell from the glass shelf upon which it stood. Again, in Mr. Oatfield's similar establishment at the west end of High Street, only one or two small articles fell, whereas several chimneys were seriously damaged near the corner of Broad Street and West Street, only about fifty yards distant."

2. *Hereford*.—Mr. J. Hartree. 3. 5.34 A.M. 4. ab. 3 prin. vibra, p. and f. by trem. mot. The movement wave-like, but not from one direction only, rather from two or three directions. 5. ab. 6 or 7 secs. 6. 8, books were moved out of their shelves two or three inches. One of my chimney-pots broken. 7. a rumbling, like ab. six traction-engines passing close by, c. and f. the sh. c. f., perhaps 30 secs.

3. Do.—Mr. W. Parlby, C.E. 3. 5.32. 4. a violent rocking or oscillation of the bed, acc. by a tremulous jarring sensation. g. N.W. to S.E. 6. 7, the pictures on the walls were observed afterwards to be out of the perpendicular. An ornament on a bracket on the wall was thrown down and broken. A slight crack made in the ceilings of a bedroom and the kitchen. 7. imm. after the vibra. a loud subterranean noise, acc. by reports resembling the distant booming of heavy artillery. c. f., ab. 10 secs.

4. Do.—Mr. H. G. Barton * (c. by Mr. H. Cecil Moore). 3. 5.33 to 5.34. 4. a. no. b. one series, strongest near beginning, and dying away, 1 to 2 secs. c. yes, 2 to 3 secs. g. N.E. to S.W. 6. 7, clocks both up and down stairs stopped at the above time. 7. a heavy steam-roller; also a piercing whirring in the air, wh. died away with a rumble like distant thunder. c. f. d. no. e. p. f. yes.

5. Do.—Mr. J. Carless * (c. by Mr. H. Cecil Moore). 3. 5.32 to 5.33. 4. c. no. e. middle and end. f. yes. 5. ab. 12 to 14 secs. 6. 8, a large chimney-stack with five flues in the house next to mine was so shaken that about ten feet had to be removed the next day. 7. a heavy grinding sound in the distant N.N.E., wh. increased until apparently under the house, wh. seemed to be collapsing and falling in. Almost imm. this ceased, there was an alarming report of a bomb-like character.

6. Do.—Mr. W. Pilley * (c. by Mr. H. Cecil Moore). 3. 5.32.* 4. a trem. or shaking mot. f. by a lifting sensation or rocking. g. S.W. to W. 5. ab. 6 secs. 6. the ceilings in two of my rooms on the ground-floor are badly cracked from E. to W. 7. a heavy cart approaching in the distance, increasing in int., f. by two very distinct crashes like a huge chimney falling, with a slight pause between them. The so. ended suddenly.

7. Do.—Anon. (c. by Mr. H. Cecil Moore). 3. ab. 5.35. 4. a slight trem. vibr. for a few secs., wh. increased until the greatest upheaving appeared to be just under the house. 5. prin. vibra. ab. 15 secs. 6. 8, in the adjoining houses chimney-tops and inside flues were thrown down.

8. Do.—Mr. E. F. Morris.† 3. 5.33. 4. the vibra. grad. incr. and dim. e. middle. f. no. 5. ab. 15 secs. 6. < 5. 7. a rumbling so. like a train going through a tunnel, or a very heavy luggage-train over a bridge, approaching and receding. c. c. d. grad. died away. e. c. app.

9. Do.—Rev. J. Trumper.* 3. 5.30. 4. f. yes. 5. ab. 15 secs. 6. 5. 7. a rushing unearthly so. b. p. ab. 3 secs. So. ceased as the sh. began.

10. Do.—Miss E. Love.† 3. 5.35. 4, 7. awakened by a loud crash; then the house appeared to be lifted from its foundations, shaken backwards and forwards several times, this being acc. by a rumbling noise. Then came another crash, exactly like a chimney falling through the roof.

11. Do.—Dr. J. Oswald Lane.* 3. 5.32. 4. a. yes. b. one series, 3 or 4 secs. c. yes, 2 secs. d. yes. e. middle. g. S. to N. 6. 4. 7. subterranean thunder. b. c. c. c. d. yes. e. c. f. no.

12. Do.—Miss J. Beresford. 3. 5.30. 6. 7, a jug in a wash-hand basin fell. 7. a heavy peal of thunder.

13. Do.—Anon. (c. by Mr. W. Merewether). 3. 5.32.* A watchmaker, whose shop is near the Cathedral, "tells me that a large clock in his shop, which he uses to time all his other clocks by, stopped at 5.32"

14. Do.—Rev. Canon Sidney Smith † (*The Times*, Dec. 19). 3. ab. 5.30. 6. 7, the ceiling of the drawing-room, wh. is on the upper floor, was cracked across, and pieces dropped from it, and small articles were thrown down. 7. a loud noise.

15. *Abbeydore*.—Rev. A. Phillipps. 3. 5.30. 4. A strong sh., f. within a few secs. by two slight ones. 5. 15 secs. or more. 6. < 5. 7. a so. like an explosion, then a rumbling like a traction-engine passing.

16. *Allensmore*.—Rev. J. E. Grasett. 3. ab. 5.35. 4. a. yes. b. one series of prominent vibra., ab. 30 secs. c. no. d. yes. e. middle. f. yes. 6. 7. 7. the so. of an approaching train and then something like blasting or an explosion.

17. *Ashperton*.—Mr. E. Griffiths.* 3. 5.45. 4. a. yes, ab. 1 sec. b. one series, ab. 3 secs. 5. ab. 4 secs. 6. 8, cracks in the walls of houses. 7. a rumbling so. b. p. a little. d. yes.

18. *Aston Ingham*.—Rev. H. L. Whatley.† 3. 5.35. 4. one series. 5. ab. 3 secs. 6. 7. 7. noise heard.

19. Do.—(*Hereford Times*, Dec. 19.) 6. 8, the chimneys of two cottages were shaken down, and chimney ornaments, dishes, and plates fell to the ground. 7. sh. acc. by a loud rumbling noise.

20. *Avenbury*.—Anon.† (c. by Miss Gaskell). Awakened by a bang like an explosion, and then it seemed as if a giant were rocking the bed.

21. *Aymestrey*.—Rev. J. S. Sidebotham.† 3. 5.40. 4. felt no sh. 7. two noises, each lasting a very few secs, separated by an interval of a few secs.

22. *Ballingham*.—Rev. G. H. Colville.† 3. 5.32. 4. awakened by a sudden and violent shaking of the bed. The feeling was that of lying in a rear carriage of a train when going over points. 5. 2 or 3 secs. 6. 8, parts of chimneys fell at cottages in the parish. 7. a loud roar like thunder, wh. seemed to go from N. to S. c. f., ab. 2 secs. d. yes.

23. Do.—Mr. A. Stone (c. by Mr. H. Cecil Moore). 6. 8, at the Hall part of a chimney fell.

24. *Bartestree*.—Anon.* (c. by Mrs. H. Barneby). 4. two sha. felt, one directly after the other. 7. a rushing so. like a hurricane p. the first sh., and a deafening noise like thunder c. with them.

25. *Bodenham*.—Dr. B. Hall.† 3. 5.33½. 4. g. N. and S. 6. 7. 7. a steam-roller moving away in the distance.

26. *Brampton Bryan*.—Rev. H. C. Green-Price. 3. 5.30. 5. a few secs. 6. < 5. 7. a large traction-engine close under the window.

27. *Bradenbury Court*.—Mrs. H. Barneby.* 3. 5.33. 4. two violent shs., one following the other imm. 5. ab. 8 secs. 6. < 5. 7. a rushing so. like that of a hurricane before the sh., then a loud noise like thunder beginning with the first sh.

28. *Bredwardine*.—Rev. H. T. Williamson.† 3. 5.30. 6. < 5. 7. at the beg. there was a so. like that of a traction-engine passing close to the house.

29. *Brilley*.—Rev. W. Head.† 3. 5.38. 4. a. yes, 2 or 3 secs. b. one series, not more than 2 secs. c. yes, ab. 6. or 7 secs. d. yea. f. yes, bed raised and slightly rocked from side to side. 5. 10 or 12 secs.* 6. < 5. 7. a heavily-laden waggon passing. b. p.

30. *Brimfield*.—Rev. J. G. Garton.† 3. 5.30. 4. one strong vibr. 5. 2 or 3 secs.

31. *Broad Oak*.—Mr J. Knight (*Hereford Journal*, Dec. 19). 3. bet. 5.30 and 6. 6. 7, in one cottage a number of articles standing on a chest of drawers fell over; in another house a lamp was shifted a few inches. 7. the sh. was acc. by dull and hissing sounds.

32. *Brockhampton*.—Mr. A. Stone (c. by Mr. H. Cecil Moore). 6. 8, in one house, the chimney-stack broke off level with the roof, and broke through the roof and ceiling below.

33. *Bromesash*.—Mr. R. Beavan.* 3. 5.34. 4. noise and trembling, 8 to 10 secs.; interval of ab. 2 secs.; then strong oscillations, ab. 2 secs., wh. caused the obs. (who was standing facing N.) to sway first to left and then to right. 5. ab. 14 or 16 secs. 6. 7. 7. the so. before the sh. like that of an approaching traction-engine; after the sh. it was more of a cracking nature. b. p.

34. *Bromyard*.—Mr. F. Philpott. 3. 5.32. 5. ab. 10 secs. 6. 7. 7. as if a large sewing-machine in the workroom overhead were being pulled across the floor. b. p.

35. Do.—Rev. W. Martin.* 3. 5.34. 5. ab. 5 secs. 6. < 5. 7. a loud rumbling so. and crash.

36. Do.—Mr. T. V. Philpott.† 3. 5.35. 4. one series of vibrs. f. no. 5. ab. 3 secs. 6. no damage done. 7. the overthrow of a large load of stones, loud, harsh, grating. b. f. The so. after the sh.

37. *Broomy Hill*.—Mr. J. F. Symonds. 3. 5.35. 4. two distinct waves or vibrs. 5. ab. 10 secs. 6. 8. 7. a rushing noise like a hurricane approaching and passing. b. p. Total duration of eq., including sounds, 20 or 30 secs.

38. *Broughton*.—Miss L. A. Foote.† 3. ab. 5.35. 4. a gradually increasing vibr., wh. incr. until there was a violent sh. from the N. wh. made the house rock and crack. g. distinctly from N. to S., but the final sh. seemed to strike the house from the N.E. 5. ab. 6 to 8 secs. 6. a large crack was made in the plaster over an E. window of a bedroom in the N.E. of the house; the crack runs from N. to S. for ab. a yard, and is ab. $\frac{3}{4}$ inch wide at the commencement. 7. a strange rushing so.

39. *Bryngwyn*.—Mr. J. Rankin.† 3. 5.35. 4. a severe and sudden upheaval; the motion appeared to be quite vertical, so that it was impossible to determine its direction. 5. 3 or 4 secs. 6. < 5. 7. the sh. and so. simultaneous.

40. Do.—Rev. J. F. Marillier (c. by Mr. H. Cecil Moore). 6. 8, a chimney thrown down.

41. *Buckenhill*.—Mr. R. Phipps.† 3. 5.35. 5. ab. 15 secs. 7. a rumble as of a railway-train approaching; then, when the floor trembled, the noise appeared like footsteps along the passage. d. yes.

42. *Bullinghope*.—Rev. W. Elliot.† 3. 5.33. 6. 7, a picture was thrown down, a heavy candlestick on a smooth sideboard moved several inches, a slight crack was made in one ceiling. 7. a harsh grumbling so.

43. *Burghill*.—Mr. C. S. Morrison.† 3. ab. 5.25. 5. ab. 2 to 3 secs. 6. some recently repaired cracks in a brick wall were opened up. 7. a confused rumbling noise acc. the sh.

44. *Burley Gate*.—(c. by Mr. H. Cecil Moore.) 6. 8, some chimneys damaged.

45. *Cleghonger*.—Rev. E. J. Holloway.† 3. 5.30. 6. 7.

46. *Cohwall*.—Mr. J. Leworthy. 3. 5.33. 7. a very heavy rumbling noise.

47. *Cowarne Court*.—Mr. H. B. Dugmore.† 3. ab. 5.35. 4. awakened by a low rumbling noise and slight vibr. wh. grad. incr. till everything in the room trembled, and then a general heaving began, a wardrobe door flew open and the walls (of stone) made a crushing noise on every side and the timbers of the floor and ceiling creaked. This slower motion was imm. succeeded by 4 or 5 distinct waves from S. by W. to N. by E., the sensation being like that of crossing the wake of a steamer in a very short rowing boat. With the last of these waves all noise and vibr. very quickly died away. 5. ab. 15 secs. 6. 8, a good many cottages in the immediate neighbourhood had their chimneys either partially or wholly overturned, and in some cases they fell through the roof. 7. see above.

48. *Cradley*.—Rev. T. A. Ayscough. 3. 5.34. 4. a. yes, 5 or 6 secs. b. two series of prin. vibrs., 8 or 10 secs, interval of 1 or 2 secs. bet. them. c. yes, ab. 10 secs. f. yes. 6. 8, in one house a number of bricks were shaken down from a chimney. 7. a low rumbling so. as of the passage of some heavy cart; in the middle of the vibra. there was a momentary so. as of crushing or grinding. b. c. app. d. yes.

49. Do.—(*Worcester Journal*, Dec. 19.) 6. 8, [two] chimney-stacks were shaken down, and clocks, pictures and other articles were thrown down.

50. *Credenhill*.—Mr. J. Murray.† 3. 5.32. 4. two series of prominent vibra., lasting ab. 2 secs. each, ab. equal in int., interval of ab. 3 secs. between them. c. yes, very slight, 2 or 3 secs. e. beg. 5. ab. 7 secs. 6. no damage to buildings. 7. thunder. b. p. c. p. ab. 2 secs. d. yes.

51. *Croome Hall*.—Mr. W. E. Hancock.* 3. 5.34. 4. a. yes, ab. 2 secs. b. one series, 5 or 6 secs. c. no. d. yes. e. middle. f. yes. 6. 8, books thrown out of a bookcase, plaster fell and ceilings cracked; a chimney thrown down. 7. at first like a chimney falling [not the noise of the chimney before mentioned] and afterwards like thunder. b. f. ab. 1 sec. d. yes. e. f. f. no.

52. *Cusop*.—Rev. G. D. Pagden.† 3. 5.33. 4. only one sh. f. yes. 6. < 5. 7. no.

53. *Dewall*.—Rev. E. Morgan.† 3. 5.30. 4. a. yes, ab. 3 secs. b.

three sha., the second most intense, the third some secs. afterwards. 6. 8. 7. rumbling thunder. b. p. d. yes. e. c. app.

54. *Dilwyn*.—Rev. F. Mellor. 3. 5.38. 4. a. yes. b. an upheaval, f. by such a lowering that it seemed as if the house were sinking into the earth. c. yes, app. 5. ab. 2 secs. 6. 7, the part of the roof where the chancel joins the church had several slates broken and displaced. 7. the rumbling of a train going over a bridge, only intensified many times, then there was a crash such as is heard in a thunderstorm, and afterwards the rumbling died away for some secs. in a S.W. direction. b. p. c. f. e. c. the peculiar sinking feeling app. coincided with the crash.

55. Do.—Mr. T. L. Hall.† 3. 5.31½. 4. three prin. vibrs., all of ab. the same int., like the shaking caused by the passage of a heavy uneven roller through the house, the roller revolving three times. No trem. mot. f. no. 5. ab. 6 secs. 6. 7, no damage to buildings. 7. no.

56. *Dinedor*.—Rev. R. Muckleston (c. by Mr. H. Cecil Moore). 3. 5.30. 4. two series of vibrs., the second following the first imm. and much weaker. 5. ab. 5 or 6 secs. 6. 8, the church escaped injury. Every room in the house was filled with soot, mortar, and broken stones; this arose from the ruin of the chimneys; all the chimneys, eight in number, were knocked down and have had to be rebuilt. 7. if there was any rumbling, it was drowned by the crash of the falling chimneys.

57. *Dinmore*.—Rev. H. F. St. John.† 3. 5.35. 4. one series of vibrs. 5. 5 or 6 secs. 6. pr. 8, ab. 5 ft. of the spire of an old chapel was screwed round bodily and projects ab. 1½ ins. over the under portion. 7. a loud roaring rumble like the passing of an express train. b. c. c. c. d. no. f. no.

58. Do.—Mr. S. Tantrum.* 3. ab. 5.35. 4. g. S. to N. 6. 7, a lamp fell from a shelf [in the signal-cabin] and also some books, the electric bells kept ringing. 7. suddenly a so. like that of a high wind sweeping through trees and then the cabin began to shake.

59. *Docklow*.—(*Hereford Times*, Dec. 19.) 6. 8.

60. *Donnington*.—Rev. M. F. Webb. 3. 5.32. 4. two series of vibrs. e. beg. f. yes. 6. 7. 7. a train getting up steam with unusual rumbling. d. yes. f. no.

61. *Dormington*.—Rev. A. N. Cope.† 3. 5.35. 4. several vibrs. in rapid succession. e. middle. f. yes. 5. 5 or 6 secs. 6. 8, many chimneys damaged and walls cracked. 7. loud rumbling like thunder or an explosion. b. p. 1 or 2 secs. c. p. 1 or 2 secs. e. c. app. So. app. travelled from W. to E.

62. *Eardisland*.—Mr. J. Barker (c. by Mr. H. Cecil Moore). 3. 5.30. 4. g. E. to W. 5. 8 secs. 6. 8, bricks on the chimney thrown down and another chimney fell. 7. the passing of a traction-engine with a loud explosion at the commencement, passing grad. away.

63. Do.—Mr. J. Southern.† 3. 5.30. 4. one series of vibrs. 5. ab. 10 secs. 6. 8. 7. a steam-engine passing. b. p. d. no. f. no.

64. *Eardisley*.—Mr. Q. R. Darling.† 3. ab. 5.30. 4. a. yes. b. heavy sha. grad. fading away; 5 secs. c. yes. e. middle. f. yes. 6. 5, no damage to buildings. 7. first a loud so. like a heavy body falling on the floor and rolling along; then a rumbling so. like heavy waggons passing over a bridge on a rough road, grad. approaching from a N. or N.W.

direction and seeming to strike the house. b. p. Total duration of eq. ab. 15 secs., so. 5 secs., prin. vibra. 5 secs., passing away 5 secs.

65. *Eastnor Gardens*.—Mr. F. Harris. 3. 5.35. 4. a trembling and then the motion seemed like that of a vessel at sea. The prin. vibra. were in three parts, the first, lasting ab. 6 secs., much the strongest, the second and third lasting ab. 1 sec. each, interval bet. first and second ab. 4 secs., bet. second and third 2 secs. 6. < 6, trees rustled as if by violent wind. 7. a violent rushing noise like heavy hail or rain falling; the so. acc. the first sh. and with the last sh. was grad. dying away.

66. *Eaton Bishop*.—Mr. A. Watkins (c. by Mr. H. Cecil Moore). 6. 8, near the blacksmith's shop a wall was cracked and also the keystone of an arch.

67. *Ewyas Harold*.—Anon.† 3. 5.34. 4. 5 or 6 distinct upheavals or rockings, 5 to 6 secs., f. by a tremor, more than 30 secs. 6. < 5, no damage to buildings. 7. a roar as of an express train going through a tunnel, f. imm. by the upheavals. b. p.

68. *Eye*.—Rev. W. G. Buckle. 3. 5.35. 5. ab. 15 secs. 6. < 5. 7. a rushing noise like that of a hurricane under the house, f. by a grinding noise and vibra. b. p.

69. *Ford Bridge*.—Mr. T. J. Perka.* 3. 5.32.* 4. a. no. b. 3 vibra., no perceptible difference of intensity. c. no. f. no. 5. 2 secs. 6. < 6; one mile from here a chimney was shaken down. 7. thunder. b. p.

70. *Fownhope*.—Rev. T. West.† 3. ab. 5.30. 4. a very rapid horizontal movement. 6. 8. 7. thunder or the rapid movement of a traction-engine.

71. Do.—Mr. J. S. Morley.† 3. ab. 5.30. 4. the sh. might almost be compared to the vicious shaking of a rat by a terrier. 6. 8, a portion of a chimney in the observer's house fell. Several houses in the neighbourhood had chimneys broken; one near here had a peculiar twist as if partly jerked round; one house lost two chimneys, another had part of a chimney thrown across the road and walls cracked; houses built on rock or high ground escaped, those on low ground suffered.

72. Do.—Mr. A. Stone (c. by Mr. H. Cecil Moore).† 3. ab. 5.25. 4. a violent uplifting of the bed. 6. 8, part of a large brick chimney fell on the roof of the observer's house, the bricks falling on each side of the house; in another house the whole chimney-top fell and broke through the roof and part of the ceiling; parts of chimneys fell in two other houses.

73. Do.—(*Hereford Mercury*, Dec. 23.) 6. 8, a large number of chimneys fell, considerable damage being done to the roofs of houses.

74. *Garway*.—Rev. P. J. O. Minos, Ph.D.* 3. bet. 5.30 and 5.38. 4. a. no. b. one series, a sort of forward, backward and forward motion, 1 or 2 secs. c. yes, ab. 2 or 3 secs. e. beg. f. no. 6. 7, no damage to buildings. 7. before the prin. vibra. a deep dull rushing so. as of wind or steam escaping, ab. 2 or 3 secs. After an interval of ab. 5 secs. a low rumbling so. as of a heavy engine passing through a tunnel. b. p. 2 or 3 secs. c. f. 1 or 2 secs. f. no.

75. *Gayton*.—Mr. H. J. Marshall † (c. by Mr. H. Cecil Moore). 3. 5.35. 4. the motion like that of a ship put suddenly head on to a short choppy sea. 5. ab. 30 secs. 6. 8, at a neighbouring farm, a chimney-stack was

thrown down; it had 4 pots on it, two of these fell and the six top layers of bricks were distributed evenly on each side, N.E. and S.W., through the roof, but the other two pots were leaning against one another on top of the wreck; the other two chimney-stacks of the same farm have to be rebuilt; the bricks of the walls on wh. the roof-timbers rested were shifted. 7. an express train in a very resonant tunnel. b. c. c. c. f. no.

76. *Goodrich*.—Rev. D. Seaton.* 4. a. yes. b. a distinct sh. c. yes. 5. + 20 secs. 6. 7, no damage to buildings in this parish so far as known (the steeple of the church is 112 ft. high), but in the neighbourhood several chimney-stacks were damaged, and one or two walls fell, but they were in a bad state. 7. a rumbling so.

77. *Grantsfield*.—Rev. E. Hutchinson. 3. 5.32. 4. a. yes, several secs. b. one series. f. no. 6. 6, no damage to buildings. 7. the so. of a heavy door being forced over a risen stone floor. b. p. c. p.

78. *Great Moor Court*.—Mr. C. W. Radcliffe Cooke, M.P. (c. by Mr. J. G. Wood). 6. tiles shaken off.

79. *Green Farm*.—Do. 6. pr. 8, bricks fell off chimneys.

80. *Hagley*.—Anon.* 3. 5.29. 4. a shaking and rattling noise increasing in int., 15 secs., sudden cessation of shaking and noise for 1 sec., then a noiseless shiver, 1 sec. e. end. 6. 8, chimneys thrown down in cottages close by. 7. b. c. c. c. with end of first series. e. c. app.

81. Do.—Mr. W. H. Godwin.* 3. 5.33. 4. a. slight, at least 2 secs. b. 6 or 7 prin. vibrs., ab. 12 to 14 secs. c. no. d. yes. e. end. f. yes, slightly. 6. 5. 7. so. began very softly and then incr. rapidly in volume and int., towards the end (when the vibrs. were strongest) rough and grating. b. p. 3 or 4 secs. c. f. ab. 1 sec. d. yes. e. c.

82. Do.—Mr. F. Moore.† 3. 5.35. 4. the vibrs. grad. incr. in int. and ended somewhat abruptly. e. end. 5. 10 secs. 6. 5. 7. a traction-engine knocking down the house; the so. ceased abruptly when at its loudest.

83. Do.—Mr. T. Morris. 3. 5.25. 4. one series of vibrs., grad. incr. in int. and then died away. e. mid. f. no. 5. 10 secs. 6. 7. 7. thunder. d. yes.

84. Do.—Mr. F. Bray.† 3. 5.27. 4. a. yes, ab. 10 secs. b. as if the house were grinding itself into the earth. 5. 10 secs. 6. 8. 7. e. p. and c.

85. *Hampton Bishop*.—Rev. L. Corbett.† 3. 5.30. 5. ab. 6 secs. 6. 8, in one house several bricks were shaken off a chimney, in another the wall of a bedroom was badly cracked. 7. e. c.

86. Do.—Miss A. Weare.† 3. 5.35. 6. 8. 7. a very loud noise like explosions and trains. c. f.

87. *Hampton Court*.—Mr. J. H. Arkwright.† 3. 5.33. 4. c. yes. g. S.W. to N.E. 5. 3 secs. 6. 7, a chimney of a cottage one mile west of this house fell. 7. a steady gale pressure. b. p. c. f. d. yes. f. no.

88. *Hampton Green*.—Mr. C. J. Ough.* 3. 5.35. 4. The eq. consisted of two parts, (1) a loud rumbling noise, (2) after an interval of 1 or 2 secs., an uplifting motion ending in a violent horizontal sh. g. S.E. to N.W. 5. ab. 30 secs. 6. + 6. 7. a tremendous explosion or artillery practice. b. p. 2 or 3 secs.

89. *Hatfield*.—Rev. D. W. Abbott.* 3. ab. 5.45. 6. pr. 7. 7. a loud explosion, resembling blasting operations.

90. *Hay, one mile from*.—Anon.† (c. by Mr. T. B. King). 3. ab. 5.40. 4. two series of vibrs. 6. 7. 7. a rumble like guns or an explosion.

91. *Hellens*.—Mrs. Cooke* (c. by Mr. C. W. Radcliffe Cooke, M.P.). 4. g. W. to E. 6. 7? 7. at the beg. a roar like the bursting of a reservoir, f. by two crashes and the shaking of the bed.

92. *Hoarwithy*.—Mr. Lutwycke (c. by Mr. H. Cecil Moore). 6. 8, a short stunted chimney of a cottage fell.

93. *Hope Mansel*.—Rev. C. J. S. Rotton.† 3. 5.40. 6. 8? there is a long crack in the west wall of the church wh. no one had noticed before the sh. 7. a rumbling so.

94. *Hope-under-Dinmore*.—(*Leominster News*, Dec. 18.) 6. 8, in one house the chimney fell, breaking the tiles; in another the top of a chimney fell.

95. *Humber*.—Rev. C. R. A. Grant.† 3. 5.34. 6. 7? no damage to buildings. 7. prolonged deep thunder. b. p. c. p. The so. died away, the obs. thinks, as the sh. began.

96. *Kilpeck*.—Rev. E. R. Firmstone.† 3. ab. 5.32. 5. 6 or 7 secs. 6. < 5. 7. a rumbling jarring so. like that of a mineral train passing.

97. *Kingsland*.—Mr. J. H. Light. 3. 5.34. 5. ab. 8 secs. 6. < 5, no damage to buildings. 7. as if a heavy carriage were passing. d. yes.

98. Do.—Anon. The church clock stopped at 5.33.

99. *King's Pyon*.—Rev. H. A. Barker.† 3. 5.33. 6. 7 or 8, stones and plaster fell down the chimney.

100. *Kingstone*.—Mr. C. E. Bullock. 3. ab. 5.30. 4. two shs, with a short interval bet. them. f. yes. 6. 8, made cracks in walls, but did not throw down chimneys. 7. no so. heard.

101. *Kington*.—Dr. H. B. Pope. 3. 5.27. 4. d. yes. e. near beg. f. no. 5. 15 to 20 secs. 6. 5, no damage to buildings. 7. a violent hurricane. b. p. imm. e. p. imm. f. no. [The so. appears to have ceased just before or soon after the sh. began.]

102. Do.—Anon.† (c. by Colonel G. F. Pearson). 3. ab. 5.35. 5. some secs. 6. < 4. 7. the noise seemed to come from the N.W.

103. Do.—Mr. D. Baldwin.* 3. 5.35. 4. b. ab. 6 prin. vibrs. c. no. d. yes. e. ab. mid. g. E. to W. 5. ab. 15 secs. 6. < 5. 7. a traction-engine passing. b. p. ab. 2 or 3 secs. c. f. d. yes, passing away with a hissing noise. f. yes.

104. Do.—(*Kington Gazette*, Dec. 22.) 3. ab. 5.30. 5. ab. 15 secs. 6. 7.

105. *Kinnersley*.—(*Hereford Times*, Dec. 19, 26.) 3. ab. 5.33. 6. 8? some bricks were displaced in a chimney.

106. *Laysters*.—Mr. H. Lovesey. 4. two shs, the first stronger. 7. a rumbling so. like thunder or a heavily-laden vehicle passing. b. p. [The so. app. ended as the sh. began.]

107. *Ledbury*.—Mr. M. A. Wood. F.R.C.S.† 3. 5.35. 4. 5 or 6 prin. vibrs., ab. 2 secs. c. yes, ab. 3 secs. f. no. 5. ab. 5 secs. 6. 8, cracks were made in the walls of several houses, but no chimneys fell. 7. no; but

to other observers the so. began like a rushing wind and culminated in a loud explosive report. b. p. c. c. d. yes.

108. Do.—Mr. J. S. Parkes.* 3. 5.32-33. 4. three prin. vibra. [series?] lasting ab. 3 secs. each, appearing to die away into one continuous tremor lasting at least 15-20 secs. d. yes. e. at end of first portion. f. yes, slightly. 6. 7. 7. distant thunder. b. p. ab. 5 secs. The prin. vibra. began after the so. ended.

109. Do.—Mr. W. J. Parr.* 3. 5.33. 4. g. N.E. to S.W. 5. 10 or 12 secs. 6. < 4. 7. no.—According to the signalman at the railway station the time was 5.34.

110. Do.—(*Ledbury Free Press*, Dec. 22.) 3. 5.30. 6. 7. 7. a so. like the wind rising, wh. rapidly incr. in int. with a great hissing noise, f. by a violent shaking.

111. *Leominster*.—Mr. H. J. Southall. 3. 5.30. 4. two distinct shs., the second following the first imm., and, if anything, the stronger of the two. 6. 7. 7. a "rushing mighty wind," wh. ended before the first sh. began.

112. Do.—(*Leominster News*, Dec. 18.) 3. 5.35. 6. 7. 7. a steam-roller passing.

113. *Letton*.—Rev. R. Bishop.† 3. 5.35. 4. the vibra. grad. incr. in int. and then decr. rather more grad. 5. 15 secs. 6. < 4. 7. no; but, according to another obs., there was a distant rumbling so. before the sh.

114. *Lingen*.—Rev. C. L. Edwards.† 3. ab. 5.30. 6. < 5. 7. a hurricane. b. c. app. c. c. app.

115. *Little Dewchurch*.—Rev. D. Cameron. 3. 5.30. 6. < 4. 7. a rumbling, at the time of the sh.

116. *Llandinabo*.—Rev. R. Evans. 3. 5.36. 4. two series of vibra., the first part stronger and lasting for 5 or 6 secs.; interval of 3 secs.; the second part, lasting 3 or 4 secs., a distinct quivering. f. yes. 5. 12 or 13 secs. 6. 6, no damage to buildings. 7. a number of very heavily-laden waggons approaching quickly. b. p. ab. 4 secs. c. p. d. a swift crescendo, then almost suddenly dying off. e. c. the so. at this moment like the roll and clatter of thunder, acc. by a grinding noise.

117. *Llangarren*.—Rev. H. J. Potts. 6. < 5. 7. rumbling, like that of a passing train.

118. *Longtown*.—Mr. L. Thain.† 3. 5.30. 4. as if some heavy man were running violently across the room, without footfall sounds; three max., each series grad. increasing and then dying away, without any quiet interval; the middle part the most violent. 5. ab. 30 secs. 6. < 5. 7. a rumbling, as of distant thunder.

119. *Longworth*.—Mr. D. McLenaghan.† 3. ab. 5.30. 4. only one series of prin. vibra. d. yes. e. mid. The motion resembled being on a rough sea, the bed being rocked from side to side. f. yes. 5. 12 secs. 6. 8, walls were cracked and chimney-pots were shifted. 7. a strong so. like a rushing wind for ab. 8 or 10 secs. before the sh.

120. *Louer Lulham*.—Mrs. Handley (c. by Mr. H. Cecil Moore). 6. 8, a chimney broke into three parts, one falling on the lawn, and another in the opposite direction over the kitchen.

121. *Lugwardine*.—Mr. W. S. Webb.* 3. ab. 5.30. 4. a. slight. b.

vibra. grad. incr. in int. until the great sh., and then f. two very distinct vibra. f. yes. g. N.W. to S.E. 6. 8, bricks fell from the chimney into the room, and glass shaken out of the window ; in many houses in the neighbourhood chimneys fell through the roof. 7. the beg. of a hurricane or wind forced violently through a tube. b. p. The so. ended like thunder at the moment when the vibra. were strongest.

122. Do.—Rev. A. C. Lee.† 3. ab. 5.30. 4. awakened by a crash, then a violent shaking, like a dog shaking a rat ; after ab. 2 or 3 mins. [sic] a second and third roar each farther off, without any sh. 6. 8. 7. underground thunder. b. p. e. p. The vibra. were strongest after the so. had ended.

123. Do.—(c. by Mr. H. Cecil Moore.) 3. 5.30. 5. app. 30 to 40 secs. 6. 7, several slates fell off the roof. 7. loud roaring noise, and sounds as if the walls of the house were splitting.

124. Do.—Anon.* (c. by Mr. H. Cecil Moore). 3. 5.30. 4. f. yes. 6. 8, chimneys cracked. 7. a traction-engine passing. b. p. c. c.

125. *Lulham*.—Mr. Handley (c. by Mr. C. Williams). 6. 8, two chimneys were thrown down. Trees were seen to sway.

126. *Lyonshall*.—Mr. T. Nixon.* 3. ab. 5.35. 4. a. yes, slight, ab. 2 secs. b. 3 or 4 prin. vibra, ab. 5 secs. c. no. f. no. 5. 7 or 8 secs. 6. 6, no damage to buildings. 7. distant thunder. b. p. 5 or 6 secs. d. yes.

127. Do.—Mr. J. T. Fletcher. 3. 5.33. 4. one sh. wh. seemed to make the bed move one inch or so to and fro. 5. 5 secs. 6. < 5. 7. a heavily-laden waggon passing along the road. b. p. 1 or 2 secs.

128. Do.—Mr. S. Robinson.* 3. 5.33. 4. f. no. 5. 3 to 5 secs. 6. < 5.

129. *Lystone*.—Rev. J. F. Marillier (c. by Mr. H. Cecil Moore). 6. 8, a chimney thrown down.

130. *Madley*.—Anon.* 3. 5.30. 4. two series of vibra. lasting ab. 4 secs. each, interval bet. them 3 secs. f. yes. 6. < 5. 7. like several traction-engines. b. c. c. f. app.

131. Do.—(c. by Mr. H. Cecil Moore.) 6. 8, a chimney fell, and also a floor in another house.

132. *Marden*.—(*Leominster News*, Dec. 18.) 6. 8? it is reported that two chimneys fell.

133. *Moccas Court*.—Rev. Sir G. H. Cornwall, Bart.† (c. by Mr. H. Cecil Moore). 3. 5.35. 4. a considerable swaying motion from E. to W. 5. ab. 5 secs. 6. < 5. 7. another obs., who was awake at the time, heard a so., as of heavy waggons driving up to the door, before the sh.

134. *Monnington-on-Wye*.—Rev. M. Marshall. 3. 5.30. 4. f. yes. 5. perhaps 10 secs. 6. < 5, no damage to buildings. 7. rumbling so. b. c. c. d. yes. e. c.

135. *Moorthampton*.—Mr. C. Williams.* 3. 5.31. 4. The sh. began suddenly ; the vibra. were so fierce and quick that they resembled the beats of an engine going at 50 miles an hour, then suddenly the vibra. ceased, and a loud crack was heard and felt as if the earth had fallen back into its socket. 5. ab. 15 secs. 6. < 5. 7. a loud weird noise resembling a fierce struggle between lions. b. c. c. c.

136. *Moreton-on-Lugg*.—Mr. C. Edwards.* 3. 5.33. 4. only one series

of vibra. ; the movement seemed to increase in int. like the rushing of a train along, and then it died away. e. mid. f. yes. 5. ab. 3 secs. 6. < 6, no damage to buildings. 7. a hollow so. like a train running over a bridge. b. p. ab. 3 secs. The so. seemed to die away a second or two before the sh. was felt.

137. Do.—Rev. C. H. Taylor.† 3. 5.35. 6. < 4.

138. *Much Marcle*.—Mr. T. Charles.* 3. 5.34. 4. a. no. b. several prin. vibra. c. no. 5. ab. 3 secs. 6. 8, in one house a chimney was much damaged, in another a window was broken. 7. a heavy waggon going quickly over a hard road. b. p. ab. 3 secs. c. f. ab. 3 secs. d. yes. e. c.

139. Do.—(*Hereford Times*, Dec. 19.) 3. 5.34. 6. 8, some chimneys in the parish were much damaged.

140. *Munsley*.—Rev. P. S. Cook.† 3. a few secs. after 5.30. 4. one series of vibra. f. yes. g. W. to E., according to most people. 5. ab. 2 or 3 secs. 6. < 5. 7. a traction-engine heavily laden.

141. *Norton Canon*.—Rev. H. B. D. Marshall.† 3. ab. 5.25. 6. 8, portions of two chimneys belonging to a cottage were thrown down ; the greater portion of the bricks fell on the west side of the roof. 7. noise heard.

142. *Nuttall*.—(c. by Mr. J. G. Wood.) 6. pr. 8, bricks fell off chimneys.

143. *Old Gore*.—Mrs. Herbert.† 3. ab. 5.40. 4. g. N.E. to S.W. 6. 7. 7. first noise (wh. woke the obs.), like the explosion of a boiler, before the sh. Imm. after the sh. there was a great noise like several waggons going rapidly down the road towards the S.W. b. p. c. f.

144. *Orcop*.—Mr. N. Dredge. 3. 5.28. 4. f. yes. 5. 5 to 7 secs. 6. < 5, no damage to buildings. 7. as if a load of hay or coal had been tilted against the side of the house. b. c.

145. *Orleton*.—Rev. W. E. Edwards.† 3. 5.36. 4. f. yes. 5. > 2 secs. 6. < 5, no damage to buildings. 7. a rushing so. from the N.W. and then a noise as of a furious blast of wind from the S.E. b. p. imm. c. f. imm.

146. *Pencombe*.—Rev. R. J. Livingstone.† 3. 5.32-35. 4. b. like two sha. close together, ab. 3 secs. c. yes, 3 to 5 secs. f. yes. 6. 7. 7. violent crashing bangs. c. f., 3 to 5 secs. e. c. app.

147. Do.—Anon.† (c. by Rev. R. J. Livingstone). 4. a rumbling noise acc. by a vibr. of the bed, this ceased for 2 or 3 secs. and then came a sh. 7. a heavy weight rolling along, pausing, then rolling again and stopping with a jerk.

148. *Pontrilas*.—Mrs. B. St. J. Attwood-Mathews.† 3. 5.30. 6. < 5. 7. a rumbling and grinding so., wh. lasted 6 or 7 secs.

149. Do.—(*Hereford Mercury*, Dec. 19.) 3. ab. 5.32. 5. > 3 secs. 7. the sh. was acc. by a deep rumbling so. like distant thunder.

150. *Preston-on-Wye*.—Rev. W. R. Shepherd.† 3. ab. 5.30. 4. one sustained series of vibra. d. yes. e. mid. f. no. 5. ab. 30 secs. 6. pr. 6, no damage to buildings. 7. a great noise like an explosion. b. c. c. c. d. yes. f. no.

151. *Pridewood*.—Rev. A. H. Knapp.† 3. bet. 5.30 and 5.35. 4. a. yes. b. then two series of vibra. in quick succession, ceasing suddenly like

an explosion; vert. mot. perceptible during the first, a violent lateral shaking with the second, and then a sensation of sinking down without any upheaval. g. S.W. to N.E. 6. 8, in a neighbouring house a chimney fell. 7. an intense noise, as if the roof were breaking beneath a heavy chimney falling, heard during the maxima of the sh. Most observers heard only a premonitory rumbling, grad. but rapidly approaching.

152. *Pudleston*.—Rev. R. B. Taylor.† 3. 5.30. 7. the crashing of some very heavy substance against the house.

153. Do.—(*Hereford Times*, Dec. 19.) 6. 8, chimney-stacks disturbed.

154. *Putley*.—Rev. J. C. Mace.* 3. 5.30. 4. the sh. seemed to begin quite suddenly; the bed seemed to be lifted up and then shaken. e. beg. f. yes. 5. ab. 7 secs. 6. 8, the chimney was so injured that it has to be rebuilt, in some places bricks fell down the chimney. 7. a very heavy steam-roller passing. b. p. ab. $\frac{1}{2}$ a sec.

155. Do.—Mr. J. Riley.† 3. 5.35. 4. two prin. vibrs. ab. 5 or 6 secs. [pr. two series of vibrs., each 5 or 6 secs.] f. yes. 5. > 10 to 15 secs. 6. 8, in one house, two or three bricks fell off the top of the chimney, the chimney of the mill was wrecked down to the ridge. Several cracks in buildings on this estate [Putley Court]. 7. so. heard. b. p. 2 or 3 secs. c. p. e. p. 2 or 3 secs. f. no.

156. *Ross*.—(*Hereford Times*, Dec. 19.) 6. 8. At Woodstock House, Gloucester Road, a portion of a chimney-stack fell with great force upon the roof. In Brookend Street, a chimney-stack fell with a crash through the roof of the house. Also at the Castle Inn (Dock Street), Merton House (Edda Cross Street), in Alton Street, and at Tudorville (ab. half a mile from the town), chimney-pots were displaced.

157. Do.—Miss G. E. Smith* (c. by Mr. E. Greenly). 4. movement of bed as of a boat at sea; two series of vibrs.; interval $1\frac{1}{2}$ secs.* g. ab. N.E. to S.W. 6. 7, two windows, wh. were unbolted, dropped several inches. 7. thunder underground. b. p. c. f.

158. Do.—Rev. E. H. Winnington-Ingram.† 3. 5.35. 4. f. yes. 6. 8, several chimneys in the town were injured. 7. so. heard. c. p. ab. 2 secs. d. yes. e. c.

159. Do.—Mr. W. F. Marvin.* 3. 5.33. 4. two series of vibrs., ab. 3 secs. each including so. (ab. 1 sec. each excluding so.), interval of ab. 4 secs.; the first sh. incr. in int. and then died away; the second, wh. was for a little more severe than the first, was strongest at the beg. and then died away. f. not with the first sh., but very distinctly with the second. 6. 8. 7. as if a large body of masonry had fallen with each sh. b. f. pr. 2 secs. in each case. c. f. pr. 2 secs. in each case. e. f. imm. in first sh., c. in second. f. no.

160. Do.—Mr. T. Morgan.* 3. 5.33. 7. a roaring noise. b. p.

161. *Rotherwas*.—Mr. R. H. Mackworth-Praed. 3. ab. 5.30. 6. < 7, three large and thick panes of glass in the conservatory were broken. 7. a noise as of bricks falling, f. at once by a violent oscillation of the house and a tremendous crash; during the sh. a rumbling noise like that heard in a house when an underground train passes near.

162. *St. Deveraux*.—Rev. T. H. Eyton. 3. ab. 5.40. 6. < 5.

163. *St. Michael's Cathedral Priory*.—Rev. Canon E. Hilary Willson,

O.S.B., and others.* 3. bet. 5.32 and 5.33. 4. a. pr. a slight trem. mot., 3 or 4 secs. b. then 5 or 6 strong vibrs. up and down, the last being the strongest of all. d. the vibrs. incr. to a max., and then seemed to cease suddenly. e. end. f. yes. g. the sh. seemed to come from the S.W. or S. Others thought it travelled from N.E. to S.W. or from E. to W. 5. bet. 2 and 5 secs. 6. 7? 7. the sh. was p. for 2 or 3 secs. by a so. compared by some to a storm or hurricane rushing from a distance, by others to a moaning which, at the first moment of the sh., passed into a rumbling or thundering as of an explosion. It grew louder and louder until the last and strongest vibration was felt, and then seemed to cease quite suddenly.

164. *St. Weonards*.—Rev. L. W. Richings.† 3. 5.32. 4. awakened by violent oscillation of the bed succeeded by loud rumbling; this was f. by two distinct shs. with swaying motion of the bed from N.E. to S.W. app. 5. 3 or 4 secs. 6. 7 or 8, an old barn had the walls all cracked. 7. a loud rumbling like a heavy goods-train passing the house, ceased with the two subsequent vibrs.

165. *Sellack*.—Rev. A. Ley.† 3. 5.34 or 5.35. 4. f. very distinct. 5. 4 to 5 secs. 6. pr. 7, no damage to buildings. 7. a very loud rumbling or rattling, so loud as to drown the noise of windows, etc., rattling in the house. The so. seemed to come from the N.E. b. p. (according to an accurate obs. awake at the time).

166. *Sellack Marsh*.—(*Ross Gazette*, Dec. 17.) 6. 8, a chimney fell.

167. *Shenmore*.—Mr. A. Watkins (c. by Mr. H. Cecil Moore). 6. 8, a chimney fell and the floor of a cottage gave way.

168. *Staunton-on-Arrow*.—Rev. W. P. Babington. 3. ab. 5.30. 4. one series of vibrs. f. yes. 5. ab. 10 secs. 6. < 4. 7. a rumbling as of heavy traffic passing. b. p. ab. 6 secs. f. no.

169. *Staunton-on-Wye*.—Rev. R. G. Ellwood.* 3. ab. 5.30. 4. the bed seemed to rise ab. 2 feet and to drop again suddenly, then commenced a great tremulous vibr. wh. shook the windows, etc. f. yes. 6. 8, the chimneys of a farm-house were much shaken and cracked. 7. a heavy traction-engine passing close to the house. b. p. 2 or 3 secs. c. p. d. yes. e. c. f. no.

170. *Do*.—Mr. W. E. Barton.† 3. 5.35. 4. two [series of] prin. vibrs. ab. 10 secs. c. yes, ab. 10 secs. d. yes. e. mid. f. yes. The movement was first upward as if the bed was being heaved up, and then a violent lateral motion. 6. pr. < 6. 7. a traction-engine passing down the road. c. c.

171. *Stoke Edith*.—Mr. G. Badham.† 3. 5.32.* 4. only one sh. 5. pr. 4 or 5 secs. 6. 7. 7. as if an accident had happened on the railway wh. adjoins the house.

172. *Do*.—Rev. Preb. W. H. Lambert. 6. 8, five houses more or less damaged, three of them with some damage to chimneys.

173. *Stretford*.—(*Hereford Times*, Dec. 19.) 6. 8, chimney-stacks disturbed.

174. *Stretton Grandison*.—Rev. C. E. Hopton.† 3. 5.34. 4. f. no. 5. 2 or 3 secs. 6. a crack on the N. side of the house was slightly enlarged and extended. 7. a loud report like distant blasting, the so. ceased imm. and the sh. continued.

175. *Swainskill*.—Mrs. Ronalds.† 3. 5.40. 4. g. those in E-W. beds felt the oscillation from S. to N., those in N.-S. beds from E. to W. 6. pr. 7. 7. (According to those who were awake) first a rushing so. like wind down the chimney or like rushing water, then a loud rumbling and report. b. p.

176. *Tarrington*.—Mr. J. H. Wood.† 3. ab. 5.37. 5. hardly 2 secs. 7. awakened by a loud noise as if something heavy had fallen. c. c.

177. Do.—Obs. a villager bringing horses from the field (c. by Mr. J. H. Wood). 4. the ground began to rock and the ice on the road to crackle; the rocking seemed to consist of three swings, two in one direction and the other in the opposite. 7. a noise in the E. like the passing of a train. b. p. 1 or 2 secs.

178. Do.—Anon.* (c. by Mr. J. H. Wood). 6. 7, the ceiling of an upstairs room was cracked the whole length to the corner, and the crack extended down the wall to the floor. A row of flower-pots on a window-sill on the ground floor were shifted to the edge and one was tilted over on to the ground; the bed was shifted from the wall just as the flower-pots were. 7. as if a load of stones were thrown on the roof. b. p. 1 or 2 secs.

179. *Tedstone Delamere*.—Rev. R. C. Barber* (c. by Rev. G. W. Sandford). 3. ab. 5.30. 4. a trem. mot. d. yes. f. no. 5. several secs. 6. two iron bedsteads side by side were rattled together. 7. a loud noise like the heavy banging of a door or an explosion, f. imm. by the sh.

180. *Thornbury*.—Rev. J. T. Atkinson.† 3. ab. 5.30. 4. f. no. 5. ab. 10 secs. 6. < 5. 7. a noise as of a rough strong wind (according to another obs.). b. p.

181. *Thruston*.—Rev. R. H. Bird (c. by Mr. H. Cecil Moore). 6. no serious damage to buildings.

182. *Tram Inn station*.—Signalman on duty.* 3. 5.32.* 4. a. yes, ab. 5 secs. b. two prin. vibra. ab. 2 secs. c. yes, ab. 8 to 10 secs. d. yes. e. beg. 5. ab. 15 secs. 6. < 4.

183. *Ullingswick*.—Rev. J. M. Ware.† 3. ab. 5.30. 5. ab. 8 or 10 secs. 6. < 5, some bricks fell off chimneys, but they may have been loose before. 7. underground thunder.

184. *Upper Sapey*.—Rev. J. B. Hewitt.† 3. shortly after 5.30. 6. < 5. 7. thunder or a passing engine.

185. Do.—Anon. 3. 5.35. 4. a swaying motion. 5. 2 or 3 secs. 6. 6. 7. thunder. b. pr. p. by 1 or 2 secs.

186. *Upton Bishop*.—Rev. A. Pope. 3. ab. 5.30. 6. 8, in one house a chimney-stack was loosened and part of it fell on the roof.

187. *Walford*.—Mr. A. P. Currie.† 3. 5.30. 4. awakened by the bed being violently shaken backwards and forwards, N. and S., two or three times, and then by a side movement, after wh. the house seemed to settle from its oscillations. 7. a heavy waggon passing over stone paving (according to another obs.).

188. *Wellington*.—Rev. G. W. Voysey.* 3. 5.30. 6. 8? some bricks off one chimney fell. 7. thunder. b. c.

189. Do.—(c. by Mr. C. Fortey.) 6. 8, some property suffered severely by chimneys falling, etc.

190. *West End*.—(*Hereford Times*, Dec. 19.) 6. 8, chimney-stacks disturbed.

191. *Westhope Hill*.—(*Hereford Times*, Dec. 19.) 6. 8, a cottage injured.

192. *Weston Beggard*.—Rev. S. J. Butcher. 3. 5.35. 5. ab. 10 secs. 6. 8, three earthenware chimney-pots were thrown down at the Vicarage, and the stonework and masonry supporting them were dislodged.

193. *Weston-under-Penyard*.—(*Western Mail*, Cardiff, Dec. 18.) 6. 8, at Weston Lodge, several chimney-pots were displaced and a large crack was made in the chimney-stack.

194. *Whitchurch*.—Anon.† 6. pr. 7.

195. *White Cross*.—Mr. W. Merewether.* 4. a succession of throbs, f. by a shaking of the bed for ab. 3 or 4 secs. as though strong hands on the N. side had seized it in the middle and shaken it across two or three times; after an interval of ab. 5 secs., a second but slight sh., also transverse, lasting ab. 2 secs.; possibly a third but still weaker sh., only momentary. 6. pr. 7. 7. a very heavy thud, as of an explosion to the N., succeeded after 5 secs. of silence by the throbs with a peculiar muffled so., and also by a so. like that heard when in an express train rushing through a station, and ceasing suddenly before the shaking of the bed began.

196. Do.—Anon. (c. by Mr. W. Merewether, in same house). 3. 5.35. 4. g. E. and W. (see no. 195).

197. *Whitney*.—Mr. M. Morgan. 3. 5.28. 4. a very trem. mot. 5. ab. 10 secs. 6. no damage to buildings.

198. *Wigmore*.—Mr. J. W. Palmer. 3. 5.30. 4. a. yes. 2 or 3 secs. b. one prin. vibr., 1 sec. c. no. e. end. f. no. 6. < 5. 7. tipping a load of coal. b. p. 2 or 3 secs. c. c. e. c.

199. *Wilton*.—Mrs. Key.* 3. 5.30. 4. only one sh. 5. ab. 3 or 4 secs. 6. < 4. 7. considerable rumbling so. b. c. c. c.—But according to most observers round the house, 7. b. p. c. f.

200. *Winforton*.—Rev. C. J. Down.† 3. 5.35. 4. f. yes. 6. < 5, no damage to buildings. 7. a very heavy rumbling coming from the W.

201. *Wintercott*.—(*Hereford Times*, Dec. 19.) 6. 8, chimney-stacks disturbed.

202. *Withington*.—Rev. R. Powell.† 3. 5.35. 5. 30 secs. 6. 8, several chimneys were thrown down on houses near the Rectory. 7. awakened by a loud crash, afterwards there was a second less loud report.

203. Do.—(*Hereford Mercury*, Dec. 23.) 6. 8, a number of chimneys thrown down, and the front of a brick-built house cracked from bottom to top. 7. (according to observers who were out of doors) the noise was like that of an approaching storm, with a kind of buzzing so. wh. grew in int. until the sh. came, and then passed away with a light rattling so.

204. *Wolferlow*.—Rev. F. B. Grant.† 3. 5.30. 5. 20 secs. 7. a rumble.

205. *Woolhope*.—Rev. T. M. Beavan.† 4. b. two distinct series of vibra., each incr. in int. and then grad. died away. c. yes. f. yes. 5. not many secs. 6. 8. 7. as if chimney-pots were rolling down the roof. d. yes.

206. *Wormbridge*.—Mr. F. W. Francis. 3. ab. 5.30. 4. two series of vibra., 2 or 3 secs. apart, the vibra. strongest at beg. and grad. died away. f. no. g. N.N.E. to S.S.W. 6. < 5, no damage to buildings. 7. a

rumbling so. like an explosion. d. yes. The vibra. began when the so. had nearly died away. The so. seemed to travel in a S.S.W. direction.

207. *Wormesley*.—(c. by Mr. J. Murray.) 6. 8, a cottage chimney-stack thrown down.

208. *Wormilow*.—(c. by Mr. J. Rankin.) 6. 8, two chimney-stacks thrown down.

209. *Yarkhill*.—Rev. A. G. Jones.* 3. 5.33. 4. a. no. b. one heavy crash, 1 or 2 secs. c. yes. 6 or 8 secs. e. beg., int. grad. diminished. f. yes. g. N.E. to S.W. 6. 8, one stack of chimneys is seriously cracked, and, from below, appears to be twisted and to lean towards the S.W.; a door-frame was slightly twisted, so that the door would not shut properly. 7. at first a rumbling so. like a heavy goods-train in a tunnel, acc. with a whirring noise like a whirlwind; this so., which only lasted ab. 5 or 6 secs., incr. in int. until the house seemed to be struck with a heavy crash, and the noise passed on and soon died away. b. p. c. p. e. c.

GLOUCESTERSHIRE

210. *Acton Turville*.—Rev. W. S. Fossett. 3. 5.40 A.M. 5. 2-3 secs. 6. 5 ? 7. a very heavy engine travelling over a frosty road. b. p.

211. *Aldsworth*.—Rev. G. H. Barrett.† 3. ab. 5.30. 7. a rumbling so.

212. *Almondsbury*.—Mrs. Hookings.* 3. 5.35. 4. sh. felt. 7. a very heavy vehicle or traction-engine; the so. seemed to pass from E. to W.

213. Do.—(*Bristol Observer*, Dec. 19.) 3. 5.33. 5. ab. 10 secs. 6. 5. 7. distant thunder; the so. seemed to travel towards the S.

214. *Ampney Crucis*.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 6. pr. 7.

215. *Ampney St. Peter*.—Rev. F. D. Bateman.† 3. 5.34. 4. app. three series of vibra., ab. 3 secs. each, with an interval of barely 2 secs.; the second series seemed stronger than the third. 6. 4. 7. some of the villagers heard a rushing so.

216. *Andoversford*.—Mr. E. Upstone.* 3. ab. 5.33. 4. a. ab. 20 secs. b. two distinct series, ab. 10 to 12 secs. each, interval ab. 2 or 3 secs., the second series much stronger than the first. c. no. e. end. f. yes. 5. 50 to 60 secs. 6. 5. 7. after the sh. a moaning so. wh. died away to a sigh.

217. *Ashchurch*.—Rev. H. Leach. 3. ab. 5.30. 4. slight trem. mot., wh. grad. incr. in int. to violent oscillations, with a sensation of one or two waves passing under the house; only one series of vibra. 6. 5 ? 7. an express train passing by. b. p. As far as the obs. can remember, the so. seemed to be dying away as the tremor began.

218. *Ashleworth*.—Rev. B. Edwards.† 3. 5.39. 4. b. only one series for at least 6 secs. c. yes, very slight, > 2 secs. f. no. 6. 8, two chimneys thrown down, some walls cracked, bricks thrown down chimneys.

219. *Avening*.—Rev. F. de Paravicini. 3. 5.45. 4. g. W. to E. 6. 5. 7. a muffled rumbling so. throughout the shaking.

220. *Aron Lighthouse*.—Mr. J. E. Troth.* 3. 5.35. 6. a window-blind shook. 7. the explosion of a large steam-boiler, the so. came from the S.E.

221. *Avonmouth*.—Capt. C. Hodder. 3. 5.31. 4. only one sh. 5. ab. 3 or 4 secs. 6. 5. 7. an engine going off the line. b. p. ab. 1 sec.

222. *Barnsley*.—Rev. D. G. Compton.† 3. just after 5.30. 6. 5. 7. one obs. heard a so. like thunder just before the sh.

223. *Beachley*.—Miss N. Gwilliam* (c. by Rev. E. Green). 3. 5.30. 4. a. no. b. only one series. c. no. d. yes. f. yes. 5. ab. 2 or 3 secs. 6. < 4. 7. a cart coming through the house. b. p. d. yes.

224. *Beckford*.—Mr. F. Slade, C.E.† 3. 5.34. 4. a. no. b. ab. 6 prin. vibrs. c. no. d. yes. e. middle. f. no. g. N. to S. 5. 5 to 7 secs.* 6. 6. 7. a hollow rumbling so. like a railway train running over a wide span girder bridge. b. p. e. c., at this instant, it appeared to come more from the earth underneath the house instead of from a distance as at first.

225. *Bentham*.—Mr. W. B. Coopey.* 3. 5.37. 4. b. a violent jerk or bump, f. by 5 or 6 wavy vibrs. c. decided trem. mot. g. S.W. to N.E. 5. 15-20 secs. 6. < 5. 7. something like distant thunder. b. p. ab. 2 secs. c. p. 3 to 5 secs.

226. *Berkeley*.—Mr. W. R. Awdry.† 3. 5.30. 4. e. mid. 5. a few secs. 6. < 4. 7. a noise acc. the sh.

227. Do.—(*Wotton-under-Edge and Dursley Gazette*, Dursley, Dec. 19.) 3. 5.35. 6. < 6. 7. distant thunder.

228. *Bishops Cleeve*.—Mr. G. Osborne.* 3. ab. 5.33. 4. like the shaking caused by an underground railway train in a house near the line, but much greater. f. no. 5. quite 3 secs. 6. < 4. 7. a very heavy waggon passing quickly along the road. The sh. began the instant the so. ceased.

229. Do.—Rev. T. Jeason.† 3. ab. 5.35. 5. only a few secs. 6. < 4. 7. a heavy luggage train passing close under the window, the so. ended very abruptly.

230. Do.—Head servant,* out of doors (c. by Mr. G. Osborne). 6. 7. 7. a so. like a large flight of birds approaching, and increasing in volume; it then became a humming so. like the noise in the insulators of telegraph wires, and incr. greatly and became very loud as it apparently passed him overhead, but at no great height; it then stopped suddenly, and at that instant the ground shook under him so that he was unable to move. Duration of so. and sh. ab. 4 or 5 secs.

231. *Bishopston*.—Mr. J. T. Davies † (*Western Daily Press*, Bristol, Dec. 18.) 3. ab. 5.40. 4. short, regular, jerky movements. 5. ab. 20 secs. 6. < 4.

232. Do.—Mr. J. W. Tutchter* (*Western Daily Press*, Bristol, Dec. 18.) 3. 5.33. 4. vibrs. at rate of ab. 100 per minute. g. E. to W. 5. 30 secs. 6. < 4.

233. *Blakeney*.—Rev. A. D. Pringle. 3. 5.34. 4. the bed rocked 6 times, the movements equally strong. f. no. 5. 6 secs. 6. 7? a cowl on one chimney-top was put out of gear. 7. a loud noise like a heavy waggon going quickly down a hill. b. p. c. p. d. no.

234. Do.—(*The Times*, Dec. 18.) 4. the movement consisted of one principal oscillation, f. by a tremor wh. lasted several secs. g. W. to E. 7. a rumbling report not unlike that produced by an immense waterfall.

235. *Brimpsfield*.—Rev. R. H. Denne.† 3. 5.35. 5. ab. 10 secs. 6. 7. according to other observers, a loud so. like a chimney on fire p. the sh., becoming inaudible as the vibra. began.

236. *Brinscombe*.—(*Stroud Journal*, Dec. 18.) 3. ab. 5.30. 4. a heavy rolling sh., f. by an intense vibr. lasting for several secs. 6. < 4.

237. *Bristol*.—(*Daily Telegraph*, Dec. 18.) 6. in Akerman Road, Southville, an oil-lamp wh. was on a bracket fell to the floor; West Street, in one bedroom two pictures and a photograph frame were dislodged.

238. Do.—Mr. F. W. Stoddart.† 3. 5.33.* 4. vibra. most violent on waking and grad. died away. f. no. 6. 6. 7. a very heavy waggon passing app. eastward. d. grad. died away. e. c. pr. f. no.

239. Do.—Mr. E. C. Cousens. 3. 5.35. 4. bed rocked violently. g. W. to E. 5. < 5 secs. 6. 5. 7. no so. heard.

240. Do.—Anon.† (*Bristol Observer*, Dec. 19.) 3. 5.35. 4. a violent shaking of the bed, a rather pleasant rocking sensation. 5. 4 or 5 secs. 6. 5.

241. Do.—Miss C. E. Barnard † (c. by Mr. E. Greenly). 3. 5.30. 4. Two series of prin. vibra., each of wh. lasted 2 secs. and ended abruptly, a perfectly quiet interval of $1\frac{1}{4}$ secs., the second series the stronger but not markedly so. c. no. f. no. 5. $5\frac{1}{2}$ secs.* 7. a heavy traction-engine going by, the so. appeared to be coincident with each sh.

242. Do.—Mr. J. C. Withers * (*Western Daily Press*, Dec. 18). 3. 5.34. 4. two series of vibra., period of the vibra. ab. $\frac{1}{4}$ sec. g. S.W. to N.E. ? 6. 5.

243. Do.—Anon.† (*Daily Telegraph*, Dec. 18). 4. four definite shakings. 7. a low dull so. c. p. a few secs.

244. *Broadwell*.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 6. pr. 7.

245. *Brockampton*.—Mr. H. Rudd.† 3. 5.32. 4. two series of vibra., the second following the first after a few, perhaps 10 secs.; the second part stronger, lasting ab. 6 secs., the bed rocking to and fro. 6. pr. 7. 7. a rumbling and rustling so. c. f. 4 or 5 secs.

246. *Brockworth*.—Rev. J. H. Seabrook.† 3. 5.35. 4. b. two prin. vibra. c. yes, ab. 20 secs. d. yes. e. mid. f. yes. 6. 8. 7. roaring of lions. b. p. d. yes.

247. *Brookthorpe*.—Rev. E. J. Houghton.† 3. 5.25. 4. f. yes. g. N. to S. 6. pr. 8. many cracks made and existing cracks increased. 7. loud continuous rumble, like platoon-firing.

248. *Buckland*.—Rev. C. P. Brickwell.† 3. ab. 5.25. 4. f. yes. 5. pr. 5 or 6 secs. 6. 5.

249. *Bussage*.—Rev. N. D. Macleod † (*The Times*, Dec. 18). 4. 10 or 12 distinct vibra., f. an instant or two later by a quivering of the earth [two series, first stronger]. 7. a rumbling noise.

250. *Cam*.—(*Western Daily Press*, Bristol, Dec. 18.) 6. pr. 7, tiles were shaken off one or two houses.

251. *Chalford*.—Dr. T. E. Gordon.* 3. 5.34. 4. d. yes. e. mid. 6. 5? 7. a traction-engine passing very rapidly. b. p. c. p. d. yes.

252. *Charfield*.—Mrs. R. P. Davies.† 3. ab. 5.30. 4. some persons say they felt two shs. 5. ab. 2 secs. 6. < 4. 7. a heavy cart passing.

253. *Charlton Kings*.—Mr. S. S. Buchman, F.G.S.† 3. 5.33. 4. a succession of shakes, the bed swaying to and fro; this ceased with some abruptness. e. mid. g. N. to S. 6. 6, a picture on an E. wall was tilted considerably. 7. a traction-engine passing. c. c. app. e. c.

254. *Chazhill*.—(c. by Rev. L. Wilkinson.) 6. 8, two chimneys damaged.

255. *Cheltenham*.—L. P. Nickalls.† 3. 5.30 or 5.32. 4. a. yes. b. two series of vibra., each ab. 6 secs., the first stronger, the second f. the first imm. but there was time to spring out of bed bet. them; both series seemed to incr. in int. and then decrease, and both were acc. by a so. and throbbing up-and-down movement. c. yes, ab. 20 secs. e. mid. of first sh. f. yes. The floor (seen by gas-light) seemed to heave up between the door and window, the line of bend running N. and S. 5. ab. 30 secs. 6. 7? a few books fell slanting on shelves. 7. at first like a violent gust of wind, but the so. wh. f. imm. with the sh. was as if the boiler was heaving before bursting. b. p. c. p. ab. 15 secs. e. c.

256. Do.—Mr. C. C. Prance.* 3. bet. 5.33 and 5.34. 4. first a heavy thud as if something had fallen, after a second or two a loud rumbling and quivering motion, in a moment more this shaking incr., the whole room seemed to lean outwards to the S. (a gentle lean over such as one feels in a yacht in a sudden puff of wind), and twice a wave seemed to come wh. tilted up the bed from N. to S. 5. quite 20 secs. 6. 6. 7. b. c.

257. Do.—Mr. J. Taylor.* 3. 5.32. 4. the window-frames moved, at first almost imperceptibly, but grad. increasing; ab. the third sec. the bed began to pitch like a boat in a choppy sea, 5 or 6 times, grad. subsiding with a trem. mot. 5. > 12 secs. 6. < 5. 7. the so. with the first tremors like a heavy gust of wind, with the final tremors like a distant train in the tunnel; during the prin. vibra. it was drowned by the rattling of the windows.

258. Do.—Rev. J. Robertson.† 3. 5.33. 4. a shaking, both laterally and vertically. 5. 4 secs. 6. 7? 7. a rushing or rumbling noise.

259. Do.—Mr. F. H. Cliffe.† 3. ab. 5.32. 4. a violent shaking from side to side. 6. < 5. 7. a hurricane. c. p.

260. Do.—Mr. H. H. S. Escott.* 3. 5.34. 4. two series, only a few secs. bet. them, the second stronger. 5. very few secs. 6. < 5. 7. like a distant explosion, acc. the sh. c. c.

261. Do.—Mr. R. Tyrer, F.R.Met.S.† (*Standard*, Dec. 19). 3. 5.34. 4. very rapid oscillations of the bed. 6. < 5. 7. a deep rumbling, as if a heavily-laden train were passing along the road.

262. Do.—(*Gloucestershire Echo*, Cheltenham, Dec. 17.) 3. 5.32. 4. slow vibra. rather than quick tremblings. g. N. to S. 5. 4 or 5 secs. 6. 7. "we are informed that one or two chimneys have suffered, one instance being that of Station Road school."

263. Do.—Mr. C. A. Pooley. 3. 5.34. 4. two shs., interval ab. 3 secs. g. S.E. to N.W. 6. < 4, water was spilled from basins. 7. the first sh. acc. by a rumbling and detonating so., the second by a peculiar crackling like that of wood-splitting.

264. Do.—Mr. S. M. Cornelius (*Gloucestershire Echo*, Cheltenham, Dec. 17). 3. soon after 5.30. 5. ab. 50 secs. 6. < 5.

265. Do.—(*Bristol Observer*, Dec. 19.) 3. ab. 5.30. 5. 3 or 4 secs.

6. 7, "in one instance a chimney in Fairview was partly demolished." 7. a traction-engine passing.

266. Do.—(*The Times*, Dec. 18.) 6. 7.

267. *Cheltenham*, near.—(*The Citizen*, Gloucester, Dec. 17, and many other papers.) "A Midland engine-driver says that, when he was some little distance from Cheltenham, he and the stoker were greatly alarmed on finding the engine lurching violently for a few secs. . . . whilst the sh. lasted it was thought that the engine would leave the metals."

268. *Chipping Campden*.—Mr. J. R. Neve.† 3. 5.35. 4. a quivering trembling sensation, only one sh. felt. 5. perhaps 10 secs. 6. < 5. 7. like thunder dying away in the distance.

269. *Chipping Sodbury*.—Mr. Leman. 4. sh. felt. 7. sh. acc. by a noise like distant thunder.

270. *Churcham*.—Rev. W. J. Selby.† 3. ab. 5.33. 4. c. yes, 15, secs. d. yes. e. end. 6. 8, several chimneys were either twisted or thrown down. 7. underground thunder. c. p. 3 or 4 secs. d. yes. f. no.

271. Do.—Mr. J. G. Bevan. 3. 5.35. 4. a. no. b. ab. 30 or 40 violent oscillations. c. no. f. yes. 5. ab. 8-10 secs. 6. 8, a piece of firestone weighing ab. 1 cwt. thrown from the top of a chimney on the E. side of the house, it fell toward the E. 7. a tremendous roar. b. c. c. c.

272. *Cinderford*.—(*Gloucestershire Echo*, Cheltenham, Dec. 17.) 3. 5.45. 5. several secs. 6. 8, bricks were thrown off several chimneys.

273. *Cirencester*.—Mr. W. Wearing.† 3. ab. 5.35. 5. ab. 2 secs. 6. < 4. 7. no.

274. Do.—Prof. T. Groom (*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19). 3. bet. 5.32½ and 5.33. 6. 5.

275. Do.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 3. bet. 5.32 and 5.33. 5. ab. 10 secs. 6. 6. 7. a dull muffled so. like distant thunder acc. the sh.

276. *Clifford's Mesne*.—Mr. O. T. Price. 3. 5.35. 4. two distinct shs., f. by very rapid but distinct upheavings. g. N.E. to S.W. 5. quite a minute. 6. 5. 7. a heavy waggon passing. b. p. ab. 15 secs. c. f. ab. 40 secs.

277. *Clifton*.—Mr. M. W. Heath. 3. 5.33.* 4. a distinct shiver, and imm. a gentle lift to the bed beginning at the E. end and ending at the W., then a final shiver. 6. 5. 7. like "the pedal notes of a great organ, only of a deeper pitch than can be taken in by the human ear, shall I say a noise more felt than heard?"

278. Do.—E. A. Holdship.† 3. 5.30 to 5.40. 4. two series of vibrs. c. yes. g. S. to N. 5. ab. 20 secs. 6. 6. 7. very heavy people rushing stamping along the hall downstairs. b. p. c. f.

279. Do.—Miss M. B. Gribble.† 3. 5.30. 6. 5. 7. no.

280. Do.—Miss V. Gribble.* 5. ab. half a min. 7. a train under the house. b. p. imm.

281. Do.—Dr. A. B. Prowse.* 3. 5.34. 4. a. no. b. one series of vibrs. c. no. g. N.N.E. to S.S.W. [i.e. perpendicular to direction of street]. 5. ab. 2 secs. 6. 5. 7. no.

282. Do.—Mr. A. Vaughan.† 3. ab. 5.34. 4. awakened by a loud

report, f. after 2 secs. by a violent vibratory motion. 7. the so. at its height suggested an explosion of gas in a neighbouring house, it died away slowly.

283. Do.—Miss E. Cooper.† 3. 5.33. 4. a rocking and swaying as at sea, f. by a jarring feeling such as is experienced when a tramcar goes off the line and drags heavily. 6. 5. 7. a deep dull roar like thunder with a vibration in it, when the jarring motion began. b. f. c. f.?

284. Do.—Mr. R. F. Sturge, F.R.Met. S.* 3. 5.33 or 5.34. 4. f. no. g. W. to E. 5. 20-30 secs. 6. 5. 7. a slight rumbling so. acc. the sh.

285. Do.—Mr. A. E. Studd.† 3. ab. 5.32. 4. continuous vibrs., without perceptible change of int. f. no. 5. ab. 6 secs. 6. 4. 7. no.

286. Do.—Mrs. Atchley.† 3. 5.25. 5. 5 secs. 6. pr. 5. 7. a heavy waggon passing or distant thunder, the sh. and so. coincided.

287. Do.—Mr. C. R. Tanner.† 3. 5.35. 4. two shs., ab. 3 secs. each. 6. 4. 7. a heavy cart passing on the road.

288. Do.—Mr. J. Wightwick. 3. ab. 5.30. 7. no.

289. Do.—L. M. Hall.* 3. 5.40. 6. 5! 7. no.

290. Do.—Mr. G. Simpson.* 4. the bed swayed as a boat does on a wash from a steamer, only evenly. 6. 5. 7. a heavy traction-engine rapidly passing the house: the so. went from E. to W. b. p.

291. Do.—(*Birmingham Daily Gazette*, Dec. 18.) 3. 5.34. 6. 6.

292. *Coleford*.—Mr. T. Newcomen. 3. 5.33. 4. the house rocked violently from N. or N.E. to S. or S.W. 5. ab. 5 secs. 6. 6. 7. a great roaring rushing noise; the end of the so. seemed to be at the commencement of the sh.

293. *Compton Greenfield*.—Rev. F. Brownson. 3. ab. 5.33. 4. [two series of vibrs., the second stronger]. 5. ab. 4 or 6 secs. 6. 5. 7. a very strong gale of wind. b. p. ab. 2 or 3 secs. d. yes. f. yes.

294. *Daglingworth*.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 6. 5. 7. a heavy traction-engine passing.

295. *Deerhurst*.—Rev. D. G. Lysons.† 3. 5.35. 4. only one series, like the motion of a ship at sea in a heavy swell. 5. several secs. 6. < 5.

296. *Dorsington*.—Rev. E. Atkinson. 3. 5.33. 4. distinct trembling vibrs. from E. to W., on reaching the house the bed heaved up from E. to W. 5. ab. 4 secs. 6. 5. 7. simultaneously with the upheaval, there was a loud rumbling in the attics above as though heavy furniture or boxes were being dragged across the floor from E. to W.

297. *Down Hatherley*.—Rev. Canon Maddy. 3. 5.30. 5. 15-20 secs. 6. 7. 7. a traction-engine passing or an explosion.

298. *Dursley*.—Mr. W. Downes. 3. 5.35. 4. the bed rocked to and fro. 5. 3 secs. 6. < 5. 7. a rumbling so. like a roller on the road; the so. ended ab. 1 sec. before the sh. began.

299. Do.—Miss C. Cooke.† 3. ab. 5.30. 4. Two [series of] prominent vibrs. g. W. to E. 5. 20 or 30 secs, roughly. 6. < 5, no damage to buildings. 7. thunder. c. f. e. c.

300. Do.—Mr. G. L. Hill.† 3. 5.33. 4. a. yes. b. two max. of int. c. yes. 6. 7, no damage to buildings. 7. a railway train passing. d. yes.

301. Do.—(*Wotton-under-Edge and Dursley Gazette*, Dursley, Dec. 19.) 3. ab. 5.30. 4. two shs. ab. 15 secs. apart, f. by a tremor. 6. < 5. 7. a roaring noise.

302. Do.—(*Hereford Times*, Dec. 26.) 6. the roofs of houses were damaged.

303. Do.—(*Western Daily Press*, Bristol, Dec. 18.) 3. ab. 5.30. 6. < 5, no serious damage done.

304. Do.—(*The Times*, Dec. 18.) 6. 7.

305. *Dymock*.—Rev. R. Horton.† 3. 5.35. 4. like the effect of a heavy express train passing beneath a house, only much intensified. d. yes. e. mid. 5. ab. 10 or 12 secs. 6. 7, a travelling-clock was thrown down on its face towards the N., photographs and light articles fell. 7. a very loud noise. e. c. f. a crashing, rending, roaring so.

306. *Ebley*.—Mrs. Webb * (c. by Dr. J. Dougall). 3. 5.30. 4. the house rocked so that it seemed as if it must soon fall. e. end. f. no. g. E. and W. 6. 5. 7. no ; other observers, however, heard the so. both before and after the sh.

307. *Elkstone*.—Rev. R. H. M. Bouth.† 3. ab. 5.35. 4. a succession of waves wh. seemed to be quite as strong at the end as at the beg. f. yes. 5. ab. 5 or 6 secs. 6. < 5. 7. a rumbling so, and as the eq. died away a so. as of stones rolling down.

308. *English Bichnor*.—Rev. G. Hustler. 3. 5.40. 4. a. yes, 3 secs. b. one series, 3 secs. c. no. e. mid. f. no. 6. 4. 7. a heavy waggon or traction-engine passing. b. c. c. c. d. yes. e. c. f. no.

309. *Eyeford Park* (c. by Rev. D. Royer). 6. pr. 7.

310. *Eyford*.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 6. pr. 7.

311. *Fairford*.—Rev. F. R. Carbonell.† 3. ab. 5.25. 4. trem. mot., strongest at beg. and then diminishing continuously. f. no. 5. ab. 30 secs. 6. 5. 7. no.

312. Do.—Mr. F. Lockwood.† 3. ab. 5.35. 6. < 5. 7. a rushing wind heard close at hand.

313. *Flaxley*.—(c. by Rev. L. Wilkinson.) A labouring man going to his work says that he heard, in the direction of Gloucester [*i.e.* E.], a rumbling so, wh. seemed to be proceeding quickly towards him. The noise swept on towards him, and looking down from the hill (Littledean Hill) upon the village of Flaxley, he thought he saw the tiles on the roofs of the houses shake, like the leaves on a tree when the wind passes. He thought also that he heard them rattle. The next moment the ground shivered beneath him and he was thrown down.

314. *Forthampton Court*.—Mr. J. K. Yorke. 3. 5.32. 4. one series of vibra. 5. 3 or 4 secs. 6. 4. 7. no.

315. *Framilode*.—Mr. Blakemore (*Gloucestershire Chronicle*, Gloucester, Dec. 19.) 6. 8, two or three chimneys were thrown down.

316. *Frampton-Cotterell*.—Rev. T. W. Belcher, D.D.† 3. ab. 5.30. 4. the bed raised from the floor as if a large dog had been under it, and then dropped down again. 5. very few secs. 6. 5. 7. rushing noise like a storm.

317. *Frampton-upon-Severn*.—(*Wotton-under-Edge and Dursley Gazette*, Dursley, Dec. 19.) 6. 8 ? "we hear that some slight damage was done to property in this place."

318. *France Lynch*.—M. Atkinson.† 3. 6.20 [*sic*]. 4. was swung

backwards and forwards with sufficient violence to cause a feeling of sea-sickness. 6. \leftarrow 5. 7. a cart driven very rapidly over an intensely frost-bound road.

319. *Frocester*.—Dr. D. W. Eshelby. 4. only one series felt, the vibra. were precisely similar to those produced by a very heavy traction-engine. d. yes. f. no. 5. 8 to 10 secs. 6. \leftarrow 4. 7. the passage of an underground railway-train to a listener on the surface above.

320. *Further Barton*.—Miss J. E. A. Brown.* 3. 5.30. 4. The window-frame rattled violently and suddenly for ab. a sec. or two once; a sec. or two after, there were two rapidly consecutive slight liftings of the bed. 5. a few secs. 7. no premonitory noise.

321. *Gloucester*.—(*The Times*, Dec. 18; *The Citizen*, Gloucester, Dec. 17; *Gloucestershire Chronicle*, Gloucester, Dec. 19; *Gloucester Journal*, Dec. 19; *Gloucester Standard*, Dec. 19.) Bull Hotel, several bricks at the top of a high old-fashioned chimney were dislodged and fell down the chimney into the room below. George Street, at Mrs. Cook's Restaurant, the chimney fell through the roof of the top bedroom. Bath Villas, Park Road, in one house a chimney fell, in another a coping-stone. Chimneys also fell at Messrs. Denton and Holbrook's shop, at the corner of Mount Street and St. Mary's Square, at a house in Millbrook Street, and at the back of a shop in Northgate Street. Chimney-pots were displaced in Victoria Street and Howard Street. At St. James's Schoolhouse, the sh. dislodged a piece of masonry weighing 2 cwt. on the top of the chimney.

322. Do.—Dr. R. W. Batten.† 3. 5.35. 4. one set of vibra. of same int. throughout. f. no. 5. ab. 20 secs. 6. 8, coping-stones were thrown down on a neighbouring house, and the mullions of the N.W. window of the chapel near here were broken, a wedge-shaped piece on the inner side being taken out. 7. several traction-engines passing. f. no.

323. Do.—Dr. J. Campbell. 3. 5.33. 4. a. yes, 1 or 2 secs. b. prin. vibra. c. no. d. yes. e. mid. f. yes. 5. 4 secs. 6. 8, beds rolled on the floor, ornaments fell, one clock in the basement stopped exactly at 5.33. 6. a steam-roller colliding with the house. b. f. ab. $1\frac{1}{2}$ secs. c. c. e. c.

324. Do.—Mr. W. Bedford Smith. 3. 5.35. 4. the house rocked like a ship at sea, only one sh. f. yes. 5. 15-20 secs. 6. 7. 7. an express train. b. p. 3 or 4 secs. c. f. ab. 5 or 6 secs. d. the so. ended like a train going away from the house.

325. Do.—Mr. E. W. Lifton.* 7. an approaching so. like that of a moaning wind, as it got nearer it resembled the approach of a heavily-laden train moving rapidly. b. p. several secs. c. f. several secs.: the so. could be heard receding for several secs.

326. Do.—Mr. C. Fletcher.* 3. ab. 5.35. 4. the most prominent feature of the sh. was a decided thump as if a very heavy blow had been struck under the observer's feet. 7. a steam-roller moving in the street, but more abrupt.

327. Do.—Mr. G. Embrey (*The Citizen*, Gloucester, Dec. 17). 3. 5.34½. 5. ab. 20 secs. 6. in the top room of the house a bookcase was thrown down from the wall.

328. Do.—(*Gloucester Standard*, Dec. 19.) 3. 5.33. 4. 2 or 3 distinct

oscillations. 5. a few secs. 7. a dull mysterious rumbling, wh. incr. rapidly to a crashing so., acc. by a shaking of buildings; the loud crash was f. by a faint one.

329. Do.—"E. R. P." (*Nature*, vol. 55, 1896, p. 179). A large iron ornamental vase on pedestal, weighing at least 100 kilos., standing in the middle of a lawn on a stone foundation sunk in the ground, has been moved sideways on its foundation through a space of 3 cm. approximately in the direction magnetic N. 18° 30' E.

330. *Haselton*.—Rev. W. H. Stanton. 3. 5.35. 4. f. yes. 6. 5. 7. as if a jackdaw were struggling to save itself from falling down a chimney.

331. Do.—Mr. W. B. Minchin.† 3. 5.35. 4. awakened by a thud, as if some very heavy body had fallen overhead. 5. several secs. 6. pr. 5.

332. *Hasfield Court*.—Mr. H. R. Wintle, F.R.G.S.* 3. 5.38. 4. a. yes. b. two, possibly three, series with well-marked vibra. c. yes. f. no. 6. 7 or 8, bricks came out of a chimney. 7. a huge waggon being driven up the back-yard, with a well-marked grinding noise also during the vibra. b. p. c. f.

333. *Hawkesbury Upton*.—Mr. W. I. Cox.† 3. 5.20. 4. b. an oscillatory motion. c. no. f. no. 5. ab. 5 secs. 6. 5. 7. no.

334. *Hempstead*.—Mr. F. A. Jones.† 3. 5.34. 4. a. yes, 2 or 3 secs. b. prominent, almost violent, vibra. c. yes, ab. 1 sec. e. end. f. yes. 5. pr. > 5 secs. 6. < 5. 7. a heavy traction-engine. c. pr. c. d. so. became grad. louder but died away somewhat abruptly. e. pr. c.

335. *Hewelsfield*.—Rev. W. Shawcross.† 3. 5.32. 5. a very few secs. 7. a dull heavy so. acc. the sh.

336. *Horfield*.—"A. C."† (*Western Daily Press*, Bristol, Dec. 18). 3. ab. 5.25. 4. the oscillations were continuous and even. 6. 5. 7. distant heavy thunder.

337. *Horsley*.—Rev. W. H. S. Davies.* 3. 5.35. 4. a. yes, ab. 8 secs. b. ab. 5 to 8 secs. c. yes, 3 to 5 secs. d. yes. e. mid. f. no. g. N.W. to S.E. 5. 15 to 20 secs. 6. < 5. 7. at first like a violent wind among trees, then like a very heavy traction-engine close to the house and when at its loudest acc. by a kind of grinding noise as if a landslip were in progress. b. p. ab. 5 secs. c. f. 3 or 4 secs. d. yes. e. c.

338. *Horton*.—Rev. A. J. Begbie.† 3. ab. 5.35. 6. 5.

339. *Huntley*.—Rev. H. Miles. 3. 5.30. 5. ab. 1½ mins. 6. 8, at the Church, the stone crests on the ridge of the roof were shaken for 4½ feet and fell to the ground on the south side of the building; a stone pinnacle ab. 3 feet high was also shaken to the ground and broken; also an ornamental stone chimney over the vestry was much shaken and loosened but did not fall. 7. a rumbling noise and a crash.

340. *Icomb*.—Mr. K. C. Stephens. 3. 5. 4. two series (according to some observers). 6. pr. 6. 7. a noise heard by some observers.

341. *Iron Acton*.—Rev. G. R. Browne. 3. ab. 5.32. 6. < 4.

342. *Kemerton*.—Rev. J. J. Mercier.† 3. bet. 5.30 and 5.35. 4. sh. felt. 7. the so. of a cannon not very far away.

343. *Kingscote*.—(c. by Rev. D. Kitcat.) 6. 7?

344. *Kings Weston*.—Nurse Shellard* (c. by Mr. H. Ormerod). 3. 5.30. 4. 3 distinct vibra. 5. 3 secs. 6. 5. 7. thunder. e. c.; it

appeared to proceed from E. to W. and, as it passed under the house, the vibra. were felt.

345. *Lasborough*.—(c. by Rev. D. Kitcat.) 6. < 4.

346. *Lechlade*.—Mr. G. A. Davis.† 3. 5.35. 4. a. no. b. ab. 8 prin. vibra. c. no. e. mid. 5. ab. 6 secs. 7. a traction-engine passing. b. p. d. yea.

347. *Leighterton*.—Rev. J. B. Clutterbuck.* 3. ab. 5.30. 4. two [series of] vibra., 2 or 3 secs. each. d. incr. in int. and then ceased suddenly. e. end. g. S.W. to N.E. 5. 5 or 6 secs. 6. 5. 7. a large empty barrel rolled on hard ground; the so. c. with the sh.

348. *Littledean*.—Rev. G. A. P. Arbuthnot.† 3. ab. 5.30. 4. three distinct shs. of ab. the same int. d. appeared to come suddenly and die away at once. 5. ab. 1 min. 6. < 4. 7. a violent and loud roaring with the shs. ended with the third sh. d. yea. f. no.

349. *Longhope*.—Mr. E. Butler † (c. by Mr. J. W. Gray). 3. 5.35. 4. the movement like that of a boat. 6. 8, the chimney-stacks were badly shaken and bricks fell down the flues in several rooms. 7. wakened by a low rumbling noise, but afterwards there was too much noise and confusion to hear.

350. *Lower Slaughter*.—Mr. O. Viveash.* 3. 5.35. 4. a. no. b. a sudden vertical movement. c. no. 5. bet. 1 and 2 secs. 6. 5. 7. no.

351. *Lydbrook*.—Mrs. T. Linde.† 3. 5.35. 4. b. ab. 30 secs. c. yes, ab. 8 or 10 secs. d. yea. e. mid. f. yea. 6. 8, bricks dislodged from chimneys. 7. a splitting or cracking so. not unlike the noise of a very near peal of thunder.

352. Do.—(*Hereford Times*, Dec. 19.) 6. 8, chimney-pots removed or otherwise damaged.

353. *Lydbrook Junction*.—Mr. D. Thomas.† 3. 5.30. 5. ab. 3 to 5 secs. 6. < 5.

354. *Marshfield*.—Rev. E. F. Trotman. 3. 5.35. 6. < 4. 7. a traction-engine on the road. b. p.

355. *Matson*.—(*The Citizen*, Gloucester, Dec. 17.) 6. 8? chimneys removed and windows shaken out.

356. *Mickleton*.—(*Evesham Journal*, Dec. 19.) 3. ab. 5.30. 7. a dull heavy so. acc. the sh.

357. *Minchinhampton*.—Mr. F. Fowler.† 3. 5.35 to 5.40. 4. one series of vibra. d. yea. f. yea. 5. ab. 10 to 15 secs. 6. 7? 7. a traction-engine passing. b. p. c. p. d. became louder and then ceased suddenly. e. p.

358. *Minsterworth*.—Rev. R. Brent.* 3. ab. 5.32. 4. a. no. c. yes, several secs. f. yea. 5. ab. 10 secs. 6. 8, portions of several chimneys in the parish fell, and an outhouse wall was cracked. 7. like a steam-roller and a rushing so. as of a violent storm which seemed to pass away with a hissing so. in a southerly direction. b. pr. p. slightly. c. f. the prin. vibra. but not the trem. mot.

359. Do.—Mr. G. V. Ellis.* 3. ab. 5.35 (the signalman felt it at 5.34). 4. the bed suddenly moved upwards as if by a person underneath, and then from side to side, i.e. from N. to S.; soon after came the second sh., similar to the first, but stronger and lasting nearly as long again; f. by 4 or 5

alight vibra. grad. diminishing in int. g. N. to S. 6. 8, in eight or more houses the chimneys had to be rebuilt in part or altogether, in one house the S. wall was cracked. 7. no so. heard, but other observers heard a so. wh. some compared to distant thunder and others to the approach of a train. b. p.

360. *Miserden Park*.—Mr. A. E. Leatham.* 3. 5.33 to 5.35. 4. ab. 32 (distinct vibra., a small interval (not nearly one sec.) between the two middle vibra. 5. 9 secs. 6. 7, in the village several tiles fell off the cottages.

361. *Mitcheledean*.—Mr. N. F. Scarancke. 3. 5.31. 4. a. yes, ab. 6 secs. b. 7 or 8 well-marked vibra., ab. 5 or 6 secs. d. yes. e. mid. f. yes, well-marked. 5. > 12 secs. 6. 8, three chimneys fell, more cracked,



FIG. 1.

many walls and ceilings cracked. 7. a distinct rumbling like children running ab. in the passage. b. c. c. c. d. the so. of the same int. up to the main sh., then suddenly incr. and afterwards died away. e. c. f. yes, at the instant of the main sh. the noise very loud, a sharp rattling crash, exactly resembling the noise made by a falling building.

362. *Do*.—Mr. J. Abel.† 3. bet. 5.30 and 5.40. 4. e. end. f. no. 6. 8, cracked the wall of the entrance hall, some of the chimney-pots in the town came down. 7. as if two fast trains had telescoped.

363. *Mitcheledean Road Station*.—Mr. T. J. Borres. 3. 5.33. 4. a. no. b. one series. c. yes, 15 secs. d. yes. e. mid. f. yes. 5. 30 secs. 6. 8, clocks stopped at 5.33. 7. a flock of birds flying out of a tree.

364. *Moreton-in-Marsh*.—(c. by Rev. S. Jones.) 6. < 5.

365. *Do*.—(*Evesham Journal*, Dec. 19.) 3. bet. 5 and 6. 6. pr. 7.

366. *Myth Hill*.—Mr. G. Banaster.† 3. eq. ended 5h., 34m., 45s., the mean of two watches, the obs. wired to Greenwich for correct time. 4. wave-movement like swell at sea for 4 secs., then an exceedingly violent upward movement, app. quite vertical, f. by a deep drop and another upward movement not quite so violent; the house then seemed twisted [in the direction in wh. the hands of a watch rotate], and then back by the next wave; the sh. ended with simple wave-motion as at first for ab. 2 secs.; the vibra. were at the rate of ab. 2 or 3 per sec., but they were acc. all through by trem. mot. perhaps most distinct at the beg. of the sh. g. pr. ab. W. by S. to E. by N., chiefly. 5. pr. quite 7 secs. 6. 7. 7. the usual rumbling underground heard, but it was almost drowned by the noise made by doors, etc.

367. *Nailsworth*.—(*Stroud Journal*, Dec. 18.) 3. ab. 5.30. 6. < 5. 7. a peculiar rumbling noise, like the booming of a cannon.

368. *Newent*.—(*Worcester Herald*, Dec. 19.) 6. 8, in some instances chimney-stacks were shattered.

369. *Newnham-on-Severn*.—Right Hon. Sir C. W. Dilke, M.P.† 3. ab. 5.30. 4. a continuous and most violent shaking. c. no. f. no. 5. ab. 3 secs. 6. 7. 7. the roar of a great squall. b. p. c. p. e. p., the so. loudest as the sh. began.

370. Do.—Mr. J. S. Carleton.† 3. 5.30. 4. f. yes. 5. ab. 30 secs. 6. 8. 7. 3 or 4 distinct thuds overhead, and then the house began to sway.

371. Do.—(c. by Mr. E. W. Prevost.) 3. 5.31 to 5.34. 4. f. yes. 6. < 5. 7. a rumbling as of snow sliding off the roof, and then a rushing wind past the house going in S.E. direction: the sh. was felt when the so. had passed.

372. Do.—(*The Citizen*, Gloucester, Dec. 17.) 3. shortly after 5.30. 4. two shs. [the first stronger]. 6. < 7.

373. *Northleach*.—Rev. C. Hutchinson. 3. 5.30. 4. prin. vibra. all of the same int. f. no. g. N.W. to S.E. 5. 3 secs. 6. 5. 7. a traction-engine passing. b. p. c. p. d. yes. e. p., the vibra. were strongly felt after the so. had ceased.

374. Do.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 5. ab. 5 secs. 6. 5. 7. a rumbling so.

375. *Norton*.—Rev. R. Marks. 3. 5.33. 4. a continuous vibr. like a *cres.* and *dim.* in music. e. mid. 5. 15 secs.* 6. pr. 7. "In the village I heard of water spilt, bricks shaken down, a clock was stopped and a line stretched between two elms was broken." 7. a kind of grinding rumble. b. pr. c. c. p. the so. seemed to last for the first two-thirds of the sh. Other persons about here, fully awake at the time, describe a report f. by a rumbling noise during the vibra.

376. *Oakle Station*.—Mr. W. Norman.* 3. 5.33.

377. *Olveston*.—(c. by Mr. S. Irwin.) 3. ab. 5.25. 4. a. yes, 1 or 2 secs. b. one series, 8 to 10 secs. c. no. d. yes. e. mid. f. yes. 5. ab. 10 secs. 6. 5 or 6. 7. distant thunder. b. p. imm. c. f. 2 or 3 secs. d. yes. f. yes.

378. *Over Court*.—Mr. R. C. Lippincott † (c. by Mr. H. Ormerod). 3. ab. 5.30. 7. sh. acc. by a so. like thunder during a heavy thunderstorm.

379. *Ozenhall*.—Rev. J. H. Lorimer.† 3. 5.35. 5. 20 or 30 secs. 6. < 5. 7. like a heavy sea making the timbers of a vessel quiver and creak, and also as if the bottom of the vessel was being dragged over rocks.

380. *Painswick*.—Mr. A. G. Meeze.* 3. 5.28. 4. a deep-seated trem. mot., increasing rapidly for the first 2 secs. and dying grad. away for ab. another 4 secs. f. yes, the vibr. was purely vert. 5. 6 secs.* 6. < 5. 7. a so. wh. seemed to come up the valley from the W. and acc. from the outset by the tremor; the so. appeared to be part and parcel of the tremor; it had a deep musical undertone acc. by a whistling such as is occasionally heard in a gale at sea when the wind rushes through the cordage; the noise incr. and decr. with the sh. e. c.

381. Do.—Miss E. Wood Mason.† 3. 4.40 [*sic*]. 4. d. yes. e. mid. f. yes. 5. 30 secs. 6. 5. 7. a trem. noise like wind before the prin. vibra.

382. *Parkend*.—Mr. W. C. Halpin.† 3. 5.30. 4. a. yes, a few secs. b. one or two, 5 or 6 secs. c. yes, 3 secs. d. yes. e. mid. f. yes. 5.

10 or 12 secs. 6. 7. 7. as if a sudden and violent gust of wind had banged several doors.

383. *Pilning*.—Mr. F. C. Cane. 3. 5.53. 4. two severe sha. in quick succession. 5. ab. 2 secs. 6. 5. 7. a train passing over a wooden bridge at a great speed. b. p. imm.

384. *Redfield*.—Mr. W. Glegg.† 3. 5.30. 4. lateral vibra. d. yes. 6. < 4. 7. no.

385. *Redland*.—Mr. J. H. Vallance.* 3. 5.33. 4. [two series of vibra., the first stronger]. g. slightly W. of S. to slightly E. of N. 6. pr. 5. 7. before the sh. a so. as of a train passing, during the sh. the so. of a hurricane. b. p.

386. *Do*.—Col. S. W. Rawlins.* 3. 5.32. 4. (according to another observer) two sha., only a few secs. bet. them, the second more severe. 5. ab. 6 to 8 secs. (according to the writer, who only felt one sh.). 6. < 4. 7. heavy carts passing along a paved street. c. c.

387. *Rendcombe*.—Rev. G. A. E. Kempson.† 4. pr. two series. 6. pr. 5. 7. a rumbling so. (according to another obs.).

388. *Do*.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 3. 5.35. 6. 7? the hoarfrost with wh. some trees were thickly encrusted was all shaken down. 7. a preliminary rumbling so. like distant thunder.

389. *Do*.—Mrs. Colville. 3. 5.35. 6. < 5.

390. *Rodmarton*.—Rev. W. J. Dover.* 3. 5.34. 6. several cracks in plaster and walls that had not been seen before. 7. a loud noise like a heavy weight being dropped. b. c.

391. *Ruardean*, near.—Mr. R. W. Malsom. "When in the wood [on the way to Trafalgar] I was startled by a sort of hissing noise followed by a rumble which made the ground shake under me. The trees seemed to clash together, then tear one another apart. I had not gone many steps before the second report louder than the first (say 4 or 5 secs. between the reports), the direction appeared to be from E. to W. The whole woods seemed in an uproar, the birds flying about, sheep running as though chased by a wild beast. In that part of the wood, two streams of water meet; it seemed to stand still at the time of the shock."

392. *Rudford*.—(c. by Mr. J. Wightwick.) 6. < 5. 7. a loud noise like a traction-engine going up a hill near the house f. by a so. like the fall of something heavy.

393. *Sandywell*.—Mr. C. W. Lawrence.† 6. 4. 7. a traction-engine passing.

394. *Sapperton*.—Rev. H. T. Cropper.† 3. 5.30. 5. 9 secs. 6. 5. 7. a traction-engine passing.

395. *Sevenhampton*.—Rev. J. Storr.† 3. 5.35. 4. trem. mot. f. yes. 6. < 5.

396. *Sharpness*.—(c. by Rev. W. R. Awdry.) 6. 7.

397. *Shurdington*.—Mr. J. W. Gray.* 3. 5.33. 4. b. a series of vibra. (pr. 10 to 12). c. yes, there appeared to be a slight lull towards the mid. of the disturbance. g. N.W. to S.E. 5. ab. 5 or 6 secs. 6. 6? a somewhat dilapidated chimney was thrown down. 7. rattling and rumbling soa. acc. the sh. increasing towards the end. c. p.

398. *Stancombe Park*.—Mrs. Edwards.† 3. 5.15. 4. d. yes. e. mid.

g. W. to E. 5. 3 secs. 6. 8? cracks were found in the walls of rooms at the N.E. end of the house. 7. a traction-engine passing. b. c. c. c. d. yes. e. c. f. no.

399. *Standish House*.—A. A. King.* 3. ab. 5.30. 4. a. yes, a few secs. b. a rocking motion wh. incr. in force for 5 or 6 oscillations and then decr. for 2 or 3 oscillations. c. yes, a few secs. g. E. and W. 5. pr. > half a min. 6. < 5. 7. like tipping stones.

400. *Staple Hill*.—Dr. J. F. Brown. 3. 5.32. 4. continuous vibra. g. S.W. to N.E. 5. ab. 15 to 20 secs. 6. 5. 7. gradual approach of a heavily-laden train, the so. and sh. ended suddenly.

401. *Staunton*.—Mrs. Jay Jones.† 3. 5.35. 4. two vibra each lasting from 1 to 1½ secs. c. yes, slight, ab. 2 secs. f. no. 5. 4 to 5 secs. 6. 5? 7. a rumbling so. like distant thunder (heard by others). b. p. ab. 2 secs., the so. ended when the sh. began, it seemed to grow louder until the sh. occurred.

402. *Stinchcombe*.—Mrs. Browne.† 3. 5.30. 4. a violent jerk upwards, a pause, and a settling down again with a sideways shake. f. yes. 6. < 5. 7. a rushing roar as of a gale in the trees; the end of the so. c. with the beg. of the sh.; the so. ended suddenly.

403. Do.—Lt.-Col. Sir C. Prevost, Bart.† 3. 5.32. 4. the vibra incr. in int. to a sort of bump or jar. e. mid. 5. 10 to 30 secs. 6. < 5, a fresh crack was seen in the drawing-room ceiling next day. 7. a heavy goods-train going underneath the house. b. c. d. yes. e. c.

404. *Stoke Bishop*.—Mr. C. K. Townsend.* 3. 5.37. 4. a violent oscillation, grad. diminishing to a mere tremor until it ceased; only one distinct sh. 5. 5 secs. 6. 5. 7. a faint rumbling so. like extremely distant thunder, ab. 2 secs., then after an interval of ab. 1 sec. the sh. commenced, but while the sh. lasted no so. was heard; imm. the vibr. ceased, a faint sighing or moaning, ab. 2 secs.

405. *Stow-on-the-Wold*.—Rev. D. Royce.* 3. ab. 5.30. 4. three undulatory motions, increasing in int. 6. 6 or 7. 7. three distinct rumblings like discharges of distant cannon, preceding the sh.

406. Do.—F. M. Eaton.* 3. 5.38. 4. a violent trembling. 5. ab. a min. 6. < 5.

407. Do.—Miss G. Hippisley.† 3. ab. 5.45. 5. ab. 5 secs. 7. no.

408. Do.—J. E. Hookham.† 3. 5.35. 4. bed swayed perceptibly. 6. < 5.

409. *Stroud*.—Mr. W. B. Davis. 3. 6.34 to 6.35 [*sic*]. 4. two series, the first stronger and lasting 6 or 7 secs., interval 2 secs., the second series 4 or 5 secs. 5. ab. 13 secs. 6. < 5. 7. a rushing so. like that of a strong wind; or a hum of low pitch somewhat similar to that caused by the passage of a party of skaters over a sheet of ice; the humming most distinct at the moment when the vibra. were strongest.

410. Do.—Mr. E. Pockett.* 3. 5.30. 4. a. no. b. ab. 3 [series of] vibra., 8 to 10 secs. c. no. d. two or more max. of int. e. mid. f. no. 6. < 5. 7. trains running past and brakes suddenly applied. b. f. ab. 3 or 4 secs.

411. Do.—Mr. E. Friday.* 3. ab. 5.38. 4. a. yes, ab. 5 secs. b. prin. vibra., ab. 25 secs. c. minor tremors, ab. 30 secs. f. yes. 6. < 5. 7. the sh. seemed to be acc. by a vibrating, rushing, muffled so.

412. *Taynton*.—Rev. N. W. Shelton.† 3. bet. 5.30 and 5.35. 4. vibrs. incr. in int. f. no. 6. 7. 7. thunder; the so. f. the end of the sh. it became louder and then passed away. Another describes the noise as of a chimney falling on the roof.

413. *Temple Guiting*.—Rev. A. Grant Lane.† 3. 5.40. 4. a. yes (by other observers). b. two [series of] vibrs., ab. 30 secs. c. no, the sensation was one of rocking or rather a vessel rolling on a choppy sea. f. no. 6. 5. 7. distant thunder. b. p.

414. *Tetbury*.—Mr. J. W. Boyd.† 3. ab. 5.32. 6. 7?

415. Do.—Rev. T. G. Horwood.† 3. 5.35. 4. a soothing swaying motion, 3 backward and forward motions. c. no. d. no perceptible difference in int. or period. f. yes. g. E. and W. 5. ab. 4 secs. 6. 5. 7. no.

416. Do.—Anon.† (c. by Mr. F. Brown). 6. < 4. 7. thunder.

417. Do.—(*Stroud News*, Dec. 18.) 3. ab. 5.30. 6. furniture displaced in some cases, no serious damage.

418. *Tevesbury*.—Miss E. C. Sargeant.† 3. 5.30. 4. a. yes. b. two series of vibrs., ab. 5 secs. each. c. no. d. incr. and died away and incr. again, ending suddenly. e. end. f. no. 5. ab. 30 secs. 6. 6. 7. thunder. b. f. ab. 10 secs. c. c. d. yes. e. c. f. no.

419. Do.—Mr. F. Pullin. 3. ab. 5.38. 4. the brass handles on a chest of drawers shook 5 distinct times.

420. Do.—(*Daily Telegraph*, Dec. 18.) 3. 5.34. 6. 7. 7. a so. like the sougling of a high wind, f. by a deep rumble.

421. *Thornbury*.—Mr. J. S. Palmer. 3. 5.33. 4. a. yes, 10 or 20 secs. b. two prominent shs. ab. 3 or 4 secs. each. c. very slight. e. end. 6. < 5. 7. a rumbling so., also a noise like a hooter. b. the hooter so. p. c. the hooter so. p., the rumbling so. continued until the final sh. d. ab. the same int. throughout.

422. *Tidenham*.—M. C. Brice. 3. 5.26. 4. 3 or 4 lateral vibrs. 5. 4 or 5 secs. 6. 5. 7. a deep continuous rumble, like a very heavy roller on pavement. b. p. 2 or 3 secs. c. f. 3 or 4 secs.

423. Do.—Mr. A. Cobbold.† 3. ab. 5.30. 4. a somewhat violent tremor; only one sh. f. no. 6. 5. 7. the passage of a heavy vehicle over a bridge as heard from below, or the rushing of air up a flue or a chimney on fire. c. f. ab. 30 secs. d. grad. died away.

424. *Tirley*.—Rev. R. S. Turner.* 3. ab. 5.30. 4. a. pr. ab. 3 secs. b. the house seemed to rock like a ship at sea. f. yes. 6. 7. 7. a rumbling noise. b. p. d. the so. became grad. louder and the dying away was momentary.

425. *Tortworth*.—Mr. H. Kingscote. 3. 5.33. 4. slight, but rapid, vibr. 5. ab. 15 or 20 secs. 6. 4. 7. sh. f. by a low rumbling noise, like a traction-engine going at full speed on the road 100 yards off.

426. *Trafalgar*.—Mr. F. Brain, C.E.† 3. ab. 5.30. 4. the bed heaved from side to side. 5. 4 or 5 secs. 6. 8, some chimneys were cracked. 7. (according to another obs. who was awake) like the explosion of a cartridge of dynamite.

427. *Thyning*.—Rev. W. G. Lyon.* 3. 5.34. 4. a swaying motion, 20 secs.; then a severe vibr. grad. increasing in int. and stopping rather

suddenly, 30 to 35 secs. 5. 50 to 55 secs. 6. \leftarrow 5. 7. a traction-engine or steam-roller approaching the house; the so. ended imm. before the sh. began.

428. *Uckington*.—Rev. G. B. Roberts.† 3. 5.32. 4. a. yes. b. 5 prin. vibra. in continuous succession. c. yes, 3 or 4 secs. d. yes. e. mid. f. no. g. W. to E. 6. 7 or 8, a crack in the outer wall facing W. by N. 7. a traction-engine with trucks going very rapidly. b. p. 1 or 2 secs. c. c. or f. d. yes. e. c. f. no.

429. *Uley*.—Miss A. M. Brown.* 3. 5.30. 4. only one series. 5. 3 to 5 secs. 6. 7? 7. a very heavy waggon rolling along the road, then it seemed to come round the house, and the noise became very loud like thunder underneath and a crash as of a cartload of falling stones, at the same instant the bed was violently shaken. b. p. e. c.

430. *Upton St. Leonards*.—Rev. E. C. Scobell. 3. 5.30. 4. 6 or 7 prin. vibra. f. no. 5. 4 or 5 secs. 6. 5. 7. no.

431. *Westbury-on-Severn*.—Rev. L. Wilkinson.† 3. ab. 5.33. 4. d. yes. e. mid. g. E. and W. 5. about 5 or 6 secs. 6. 8, part of the stable chimney fell: coping-stones fell from the chimney of the National Schools, and the chimney has had to be rebuilt; part of a chimney fell at Brook Farm.

432. *Westbury-on-Trym*.—Mr. J. B. Gilmor* (c. by Mr. H. Ormerod). 3. ab. 5. 4. at first very slight, like the tremor made by a traction-engine in the distance, gaining in int. as it came nearer, and passing off the same way; just as it seemed to pass the end of the house that end was gently lifted up about a foot and gently let down again. 5. ab. 3 secs. 6. 5. 7. heavy road traction-engine, as in a piece of music, beginning softly, getting louder and fuller—chord—then grad. dying away again and lost. e. c.

433. *Do*.—Mr. G. Stephens † (c. by Mr. H. Ormerod). 3. 5.30. 7. awakened by a rumbling noise like the end of a clap of thunder, acc. by a gale causing the window to shake violently; duration of the noise ab. 3 secs.; it appeared to travel from S.W. to N.E.

434. *Do*.—Mr. J. Meadows.* 3. 5.30. 4. a. yes, as if traction-engine were passing, ab. 2 secs. b. one series, ab. 5 secs. c. yes, as before. d. yes. e. mid. f. yes. 5. 9 secs. 6. pr. 6. 7. a traction-engine passing. b. p. c. f. d. yes. e. c.

435. *Westonbirt*.—(c. by Rev. D. Kitcat.) 3. bet. 5 and 6. 4. sh. felt. 7. a waggon on a frosty road, or a traction-engine passing; some persons say they heard a hissing so. before the sh.

436. *Whitcombe Magna*.—Mr. J. O. Rigby.* 3. 5h. 34m. 30a., when the movement ceased. 4. only one series, as if some one at W. end of bed slightly lifted the bed and then shook it from W. to E. 5. ab. 5 secs. 6. 7. a load of dynamite exploding on the highroad. b. p. imm. [so. ended before or as the sh. began].

437. *Whitcroft*.—Mr. C. Cooke.* 3. 5.33. 4. two series, the first a tremor ab. 4 secs., the second, after an interval of 2 or 3 secs., a swaying motion ab. 4 secs. 6. 6, a stable lamp suspended on an iron rod 4 feet longswayed E. and W. about 6 inches on each side of the vertical. 7. a dull heavy trembling thudding so. like what might be produced by a quick

stampede of a large herd of elephants down the sloping ground to the west of the house; with the second part of the sh. a louder rolling rumbling so.

438. Do.—Anon.† (c. by Mr. C. Cooke). 4. [two series, the second stronger, interval a second or so]. 6. 7. 7. a sudden heavy thud.

439. *Wickwar*.—Rev. R. J. Lyon.† 3. 5.32. 6. < 5. 7. an explosion.

440. Do.—(*Bristol Observer*, Dec. 19.) 3. ab. 5.40. 4. two distinct sha., each lasting several secs., only a few secs. bet. them. 6. < 5.

441. *Winchcomb*.—Mr. W. Cox. 3. 5.35. 4. d. yes. 5. ab. 30 secs. 6. 6.

442. Do.—(*Evesham Journal*, Dec. 19.) 3. ab. 5.30. 4. g. W. to E. 6. < 5. 7. the sh. acc. by a rubbing, rather than a rumbling, noise.

443. *Winterbourne*.—Rev. A. T. S. Goodrick.† 3. 5.34. 6. pr. 5. 7. a heavy stone roller dragged along the floor. d. yes.

444. Do.—Anon.† 3. 5.30. 6. < 5. 7. (according to another obs. who was awake) a rushing so. as of a storm of wind rising, then a rumbling noise, and then the sh.

445. *Woodchester*.—Mr. R. Holden.* 3. 5.38. 4. the room shook just as a man would shake a riddle. 5. ab. 8 secs. 6. < 5. 7. as if some heavy body had fallen on the floor overhead, then another in quick succession, f. imm. by the sh.

446. Do.—Father V. M'Nabb, O.P.* (*Stroud News*, Dec. 18.) 3. 5.35. 4. 7. a distant so. made itself felt, together with a slight trembling of the walls and floor of the room; the so. and trembling incr. until it seemed as if some heavy cart was rumbling over the tiled cloister beneath; the so. and trembling then steadily died away, both having lasted ab. 10 secs.

447. *Wormington*.—Rev. S. Du Pré. 3. 5.30. 4. a horizontal movement, incr. in the mid. 5. 3 or 4 secs. 6. 5.

448. *Wotton-under-Edge*.—Mr. W. Adey. 3. 5.35. 4. a trembling and swaying of the ground, one series only. 6. 7. 7. a loud rumbling so. like thunder underground. b. p. c. p.

449. Do.—Mr. E. W. Read.† 3. 5.33. 4. b. 3 vibra. c. no. d. the violent shaking suddenly ceased. f. no. g. roughly N. and S. 5. ab. 3 secs. 6. 6? a few bricks fell off a chimney close by. 7. a rumbling noise.

450. Do.—(c. by Mr. E. W. Read.) 6. < 5. 7. a distinct rumbling like a steam-roller coming down the street. b. p. the most violent vibra. by ab. 5 to 10 secs. c. the so. stopped almost suddenly after the sh. e. c.

451. Do.—Mr. D. H. Forty.† 3. 5.37. 6. < 5. 7. a rumbling noise.

452. Do.—Mr. W. Williams.† 3. 5.35. 4. the house distinctly rocked from N.E. to S.W. and then rebounded. 5. 5 to 6 secs. 6. 5. 7. (according to another obs.) a so. as of some heavy substance falling.

453. Do.—(*Wotton-under-Edge and Dursley Gazette*, Dursley, Dec. 19.) 3. ab. 5.30. 6. 7.

454. Do.—(*Bristol Observer*, Dec. 19.) 3. ab. 5.35. 6. 7.

455. *Yate*.—(*Western Daily Press*, Bristol, Dec. 18.) 3. ab. 5.30. 5. several secs. 6. 6? 7. thunder.

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456. *Abberley*.—Rev. W. L. Moilliet.* 3. ab. 5.30. A.M. 4. a. yes, ab. 10 secs. b. one prin. vibr., a hard jolt, for 2 secs. c. no. d. grad. incr. in int. until the jolt. e. end. 7. no.

457. Do.—(*Worcester Journal*, Dec. 19.) 5. 4 to 6 secs. 6. < 5.

458. *Alvechurch*.—Prof. J. H. Poynting, F.R.S.† 3. ab. 5.34. 4. the vibrs. seemed to die away after the waking sh., a sideways motion in bed with foot to S.E., and also in another bed with foot to N.E. 6. < 4. 7. no, but another obs. (who was awake) heard a noise as if the wind was rushing through trees.

459. *Arley*.—Mr. J. Pugh. 3. 5.32. 4. f. bed lifted up and let down again. 5. ab. 10 secs. 6. < 5. 7. a rumbling noise, like an explosion, before the sh. for 2 or 3 secs.

460. *Astley*.—Rev. M. B. Buckle.† 3. 5.35. 6. < 4.

461. *Barnt Green*.—Miss E. Creak.† 3. 5.33. 4. only one sh. g. a few degrees N. of W. to a few degrees E. of S. 5. nearly a minute. 6. < 5. 7. no; (according to an obs. who was awake) an express-train running into a station. b. p. c. p. the end of the so. pr. p. the beg. of the sh.

462. Do.—E. A. Hadley.* 3. 5.30. 4. three distinct sha., each ab. 1 sec., int. bet. each pair ab. 1 sec., the first app. the strongest. g. S.E. to N.W. 5. ab. 6 secs. 6. < 5. 7. a dull rumbling so., coming from the S.E.: the so. ceased when the sh. began.

463. Do.—Mr. J. Moore Bayley. 3. 5.36. 4. an upheaval movement, ab. 3 vibrs., and then a sinking back movement. g. S.W. to N.E. 5. ab. 2 to 3 secs. 6. < 5. 7. a so. of strong wind from the S.W. coinciding with the sh.

464. Do.—Mrs. J. Moore Bayley.† 3. before 5.50. 4. the bed seemed to be raised and then shaken. 5. 10 secs.

465. *Bayton*.—Mrs. Ratliff. 3. ab. 5.30. 4. d. yes. 6. 5. 7. a rumbling so. b. p. d. yes.

466. *Belbroughton*.—Rev. J. H. Eld.† 3. bet. 5.30 and 5.35. 4. f. yes. 5. 6 to 8 secs. 6. < 5. 7. doubtful; (according to an obs. who was awake) a low rumbling so. like the wind getting up in the distance and rushing along with a roar.

467. Do.—Mrs. Clarke. 3. 5.30. 4. lifted twice and shaken. 6. 5. 7. a noise like shooting two loads of stones down a deep hole, one sec. bet. them, the first loudest.

468. Do.—(*Bromsgrove Weekly Messenger*, Dec. 19.) 3. ab. 5.30. 6. 7? 7. a loud rumbling noise, as of subdued thunder, acc. the sh.

469. *Beoley*.—Rev. J. S. Sandys.† 3. 5.30. 4. f. yes. g. N.W. to S.E. 6. 5. 7. the falling of clothes from a chair.

470. *Berrow*.—Rev. C. J. Houghton.† 3. 5.33. 4. a. yes. c. yes, 4 or 5 secs. d. yes. e. mid. f. yes. 6. < 5. 7. d. yes.

471. *Birlingham*.—Mr. A. W. Harding. 3. bet. 5.32 and 5.33.* 4. a. yes. b. a continuous shaking, the bed seemed raised up and down and shaken from side to side. c. yes. 5. > 10 secs. 6. pr. 7. 7. a low

rumbling so. like a heavy van coming along the road and grad. increasing in int. until the sh. was felt. b. p. 2 or 3 secs. c. p. or c.

472. Do.—Mr. C. Anderson.* 3. 5.31. 4. two [series of] vibra. 5. ab. 10 to 15 secs. 6. < 5. 7. no.

473. *Birts Morton*.—"C. W."* (*Birmingham Daily Gazette*, Dec. 19). 3. 5.30. 6. 7 or 8. 7. a mighty rushing so.

474. *Bishampton*.—Mrs. Atkinson.* 3. 5.30½. 4. a continuous swaying motion as if on a steamer at sea, 3 distinct upward waves. g. W. to E. 5. 3 secs. 6. < 5. 7. a heavy rumble, as of two or three heavily-laden carts going by, the so. seemed to travel from W. to E. b. f. c. f. 2 secs.

475. Do.—Mr. E. Atkinson.† 3. 5.20. 4. f. yes. 5. 2 or 3 secs. 6. 7.

476. Do.—(*Evesham Journal*, Dec. 19). 6. < 6. 7. a very loud noise.

477. *Blockley*.—Anon.* (*Evesham Journal*, Dec. 19). 3. 5.40. 4. 3 distinct shakes in quick succession. 6. < 5. 7. as if a heavy object had fallen in the room overhead.

478. *Bockleton Court*.—Col. R. P. Decie.† 3. ab. 5.35. 4. two max. of int. 6. 5. 7. the rush of flame in a heavy conflagration. b. p. c. c. d. no.

479. *Boughton Park*.—Mrs. Isaac.† 3. 5.35. 4. b. 5 or 6 vibra, ab. 10 secs. c. two slight shudders, ab. 3 secs. d. the first vibra. of ab. the same int., the last one rather less. g. S. to N. 5. ab. 10 to 12 secs. 6. 7. a rushing roaring so. like subterranean thunder, acc. by the roaring of wind. b. p. imm. c. p. d. yes.

480. *Bransford*.—Mr. A. Stanley.* 3. 5.30. 4. a. yes, 2 or 3 secs. b. one violent sh. d. grad. incr. until the sh. f. yes. 5. ab. 10 secs. 6. < 4. 7. a general rumbling noise. b. p.

481. *Bredon*.—Rev. H. Cavendish-Browne.† 3. 5.40. 4. a. no. b. 3 vibra. c. no. f. no. 5. 3 secs. 6. < 5. 7. awakened by a confused noise bet. a rush of wind and thunder, the so. ended as the sh. began.

482. Do.—Mrs. Wakefield.† 3. 5.34 or 5.35. 4. a violent upheaval of the bed, then the house swayed from side to side. 5. 10 or 12 secs. 6. < 5. 7. a rumbling so. c. c. (according to another obs.) the tremor commenced with a loud report like a collision on the railway-line.

483. Do.—Mr. G. H. H. Phillpotts (c. by Mr. W. Pearce). 3. 5.25. 4. a. yes. b. one series. c. no. d. yes. e. mid. f. no. g. N. to S. 6. < 4. 7. a train leaving the station. d. yes.

484. Do.—(*Worcester Journal*, Dec. 19.) 3. ab. 5.35. 4. g. N.E. to S.W. 5. 3 to 5 secs. 7. the sh. p. by a rumbling noise.

485. *Bretforton*.—Rev. W. H. Shawcross.† 3. 5.30. 4. only one sh. 6. 6.

486. Do.—(*Evesham Journal*, Dec. 19.) 3. bet. 5 and 6. 6. 6.

487. *Broadwas*.—(*Worcester Herald*, Dec. 19.) 3. ab. 5.40. 5. 40 to 60 secs. 6. < 4.

488. *Broadway*.—Mr. C. F. Hemsley.† 3. 5.31. 4. a continuous violent shaking, ab. the same int. throughout. f. no. 5. 10 or 12 secs. 6. 6. 7. no.

489. Do.—(*Evesham Journal*, Dec. 19.) 3. ab. 5.30. 4. two series, the first stronger. 6. < 6. 7. a distant rumbling so. heard first, like a distant explosion or approaching traction-engine.

490. *Bromsgrove*.—Mr. T. H. Butler.* 3. 5.40. 4. a. yes. b. ab. 18 or 20 vibra. 5. ab. 4 to 5 secs. 6. 5. 7. distant thunder, like the approach of a heavily-laden waggon coming at a brisk rate; when it appeared opposite the house, the rocking motion commenced. b. p.

491. Do.—Mr. G. K. Stanton.* 3. 5.27. 4. distinctly saw the west end of the room upheave twice, the second time less than the first; swayed backwards and forwards three times. 6. 5. 7. a deep rumbling so. wh. seemed to come from the N. b. p. ab. 10 secs.

492. Do.—Anon.† 3. 5.35. 6. pr. 5. 7. a heavy vehicle passing. c. p. very few secs.

493. Do.—(*Bromsgrove Weekly Messenger*, Dec. 19.) 3. ab. 5.35. 5. ab. 10 secs. 6. 7. 7. a heavy piece of ordnance fired at a distance. b. p.—An engine-driver on the Midland Railway reports that when near Bromsgrove he felt a distinct sh. ab. 5.30, and at first thought he had run over some hard obstacle. The tremor was, however, repeated and he then concluded that the sh. was not due to anything placed on the metals.

494. *Broom*.—Rev. J. H. Bourne.† 3. ab. 5.32. 4. b. 5 vibra. c. yes, slight. d. app. two or more max. of int. f. no. g. S.E. and N.W. 5. ab. 8 secs. 6. 5. 7. (according to an obs. who was awake) a rumbling so. b. p. c. p.

495. *Catshill*.—(*Bromsgrove Weekly Messenger*, Dec. 19.) 3. 5.35. 6. 5. 7. a deep rumbling so. like distant thunder.

496. *Chaddesley Corbett*.—Rev. D. H. Francis.† 3. 5.30. 4. f. yes, slightly. 5. ab. 20 secs. 6. < 5.

497. *Chavson*.—Mr. J. E. Bennett.* 3. 5.34. 4. a. yes, 10 secs. b. two severe shs., ab. equal in int., quite 10 secs. c. yes, 10 secs. 6. 5. 7. the approach of a hurricane or whirlwind. b. p. c. f. e. c.

498. *Church Lench*.—Rev. F. Smith.† 3. ab. 5.35. 6. pr. < 6, a clock (pr. 5 mins. fast) stopped at 5.40. 7. a large traction-engine passing.

499. *Cleeve Prior*.—Rev. J. D. Knipe.† 3. before 5.45. 4. two max., the first stronger, trem. mot. during the short interval between them. 5. ab. $\frac{1}{2}$ a min. 6. < 5. 7. a roaring so., wh. had ceased when the sh. began.

500. *Clifton-on-Teme*.—(*Worcester Herald*, Dec. 19.) 3. 5.30. 4. a severe sh.

501. *Cookley*.—Mrs. W. Smith. 3. 5.30. 4. only one sh. 5. 3 secs. 7. a slight rumbling.

502. *Craycombe*.—Mr. F. Roberts (c. by Mr. W. Pearce). 3. 5.30. 4. b. 2 vibra. c. yes. e. mid. f. yes. 6. 6. 7. a rumbling so. d. yes.

503. *Crophorne*.—Rev. W. C. Boulter.† 3. bet. 5.30 and 5.40. 4. prin. vibra. chiefly upward and downward, but also backward and forward so that the bed-head (nearly N.) touched the wall. e. end. f. yes. 7. a rumbling so. like heavy thunder or the passing of a heavy road-engine, succeeded by a rushing so. as if some heavy body had been dragged along the surface of the plaster of the wall; this ceased before the prin. vibra. began.

504. Do.—Rev. H. Wilkinson * (c. by Mr. W. Pearce). 3. 5.33. 4. a. yes, 2 or 3 secs. b. 6 or 7 prin. vibra., ab. 5 to 10 secs. c. yes, but very slight, 2 or 3 secs. d. yes. e. mid. f. yes. 6. 5. 7. an underground train. b. p. c. c. d. yes. e. p. f. yes.

505. *Defford*.—Rev. G. Swinden. 3. 5.35. 4. the bed seemed to rock

and then felt as if it were sinking down. g. N. to S. 5. nearly 30 secs. 6. 7. 7. a great noise. b. f. 3 or 4 secs. c. app. c.

506. *Droitwich*.—Mr. J. H. Hollyer.* 3. 5.30 or 5.32. 4. vibra. like those caused by a passing train at a short distance, wh. grad. incr. in int. until the bed was sensibly rocked: the vibra. died away slightly, returning almost imm. afterwards in a still more marked degree until the whole room seemed to sway, and then after one spasmodic sort of jerking sensation wh. shook the bed very violently, the vibra. grad. died away: the trem. mot. never ceased bet. the two max. 5. \leftarrow 10 secs. 6. \leftarrow 5. 7. no, but another obs. (who was also awake) heard a rushing so.

507. Do.—Obs.* a night-watchman at a modern and substantially built house (c. by Mr. J. H. Hollyer). 3. 5.35. 4. 7. he heard the windows of the house rattling, and looking towards the building saw that the spires of the turrets were shaking; almost imm. he noticed two earth-waves pass under his feet at an interval of not more than 3 secs, acc. by a rushing noise in the air as of the flight of a large flock of birds.

508. Do.—Mr. J. D. Wood.† 3. 5.35. 4. g. E. to W. 6. \leftarrow 5. 7. trees shaken by a storm.

509. Do.—(*Evesham Standard*, Dec. 19.) 3. 5.35. 6. 7.

510. *Dudley*.—Mr. J. Davis.† 3. ab. 5.35. 5. ab. 8 secs. 6. 5.

511. Do.—(*Daily Chronicle*, Dec. 18.) 6. many houses in the district were much shaken and some considerably damaged, the roofs having particularly suffered.

512. *Dunley*.—Mr. J. H. Jackson. 3. 5.28. 4. vibratory and uplifting motion. 5. ab. 10 secs. 6. \leftarrow 5. 7. an unusual rumbling noise. b. c., the end of the so. seemed to die away in an easterly direction in 7 or 8 distinct throbs in quick succession.

513. *Earls Crooms*.—Rev. G. A. A. Coates.† 3. 5.30. 6. 7.

514. *Eastham*.—Rev. H. Browne, J.P., D.L.* 3. ab. 5.29. 4. a. yes, slight. b. then two successive heavings, very distinct. f. yes. 6. \leftarrow 5. 7. a thunder-like so., came just after the premonitory trem. mot. and just before the upheaving.

515. *Eckington*.—Mr. A. W. Allard.* 3. 5.33. 4. 3 prin. vibra. 5. 4 secs. 6. 7. 7. a passing train. b. p. ab. 3 secs. c. f. 3 secs. d. yes. e. c.

516. *Eldersfield*.—Rev. S. Horner.† 3. 5.35. 4. one series of vibra. of equal int. 5. ab. 5 to 10 secs. 6. 7. 7. thunder underground. b. p. ab. 1 or 2 secs. (acc. to most observers). d. yes.

517. *Elmbridge*.—Rev. J. H. L. Booker.† 3. ab. 5.35. 4. one series, a rocking motion fairly uniform in int. f. no. 5. ab. 5 secs. 6. \leftarrow 5. 7. no.

518. *Elmley Castle*.—Mr. H. F. Davies † (c. by Mr. W. Pearce). 3. 5.35. 5. a few secs. 6. 5. 7. a very heavy person running along the passage and making the house shake.

519. *Evesham*.—L. M. Haynes.† 3. 5.35. 4. the bed was at first app. shaken from W. to E. and directly after from N. to S., the second part seeming the stronger. 5. ab. 20 to 25 secs. 6. \leftarrow 4. 7. a very great noise, commencing with a sort of rumbling, sounding, as it grew in int., as if cannon-balls were being tumbled about in the passage, passing off eventually with a

loud explosion a few secs. after the actual sh. in an easterly direction, but even after that was over it seemed as if the house were still trembling.

520. Do.—Mr. C. H. Smart.* 3. 5.33. 5. ab. 10 secs. 6. < 4. 7. distant thunder. b. f. c. f.

521. Do.—(*Evesham Journal*, Dec. 19.) 3. ab. 5.30. 5. several secs. 6. 7. 7. a loud noise like a traction-engine drawing trucks of stone down the street.

522. *Farncombe*.—(c. by Mr. C. F. Hensley.) 6. 6.

523. *Feckenham*.—Mr. W. C. Gould.† 3. 5.29. 4. bed shook violently from side to side. 6. 7. 7. a rumbling so.

524. Do.—(*Bromsgrove Weekly Messenger*, Dec. 19.) 3. ab. 5.34. 6. pr. 5.

525. *Fladbury*.—(*Evesham Standard*, Dec. 19.) 4. sh. felt. 7. after the sh. a great rumbling like the noise of a train in the distance.

526. *Frankley*.—Rev. J. H. Bourlay.* 3. soon after 5.30. 4. a. yes, ab. 2 secs. b. 5 or 6 slow and forcible vibra., app. $1\frac{1}{2}$ to 2 secs. c. yes, slight, ab. 1 sec. d. a grad. increase in int. with a more rapid cessation after the max. f. no. g. N.E. to S.W. 5. bet. 4 and 5 secs. 6. 5. 7. a loaded waggon or threshing-machine, but heavier. b. p. 2 or 3 secs. c. f. ab. 1 sec. d. yes, but not very faint at either beg. or end. e. pr. c.

527. *Goodmoor Grange*.—G. E. L. Betts. 3. 5.35. 4. the whole house commenced swaying, the bed was upheaved, then appeared to sink as if it would go through the floor, finally it was violently shaken from end to end; before the vibr. had subsided, the movement again increased, but not so violently as at first. g. W. to E. 5. 12 to 15 secs. 6. 6 or 7. 7. 7 or 8 secs. after beg. of first series a distinct rumbling so. as of an express-train travelling underground, lasting 3 or 4 secs.; before the second series ceased a dull thud resembling the so. made by the fall of a heavy weight.

528. *Great Comberton*.—Rev. R. Shelmardine.† 3. 5.33. 4. a. yes. b. a dozen prin. vibra., several secs. c. yes, some secs. d. yes. e. mid. f. yes. 5. 25 secs. 6. 6 or 7. 7. a heavy traction-engine passing or water boiling violently in boiler. b. p. c. p. ab. 15 secs. d. yes. e. p. ab. 5 secs. f. no.

529. *Great Malvern*.—Mr. J. G. R. Powell.* 3. 5.35. 4. felt only one sh., but others report a second shortly after, wh. was fainter. 5. 2 to 3 secs. 6. 7. 7. a roar like the sudden gusts wh. sometimes sweep down from the hills. b. p. ab. 1 sec.

530. Do.—Dr. S. Haynes.† 3. 5.33½. 6. 6, one of the many clocks stopped at 5.33½. 7. a rumbling as of heavy furniture-van or guns being dragged along the road. b. p.

531. Do.—Miss M. L. Ashford.† 3. 5.38. 4. two series, the second stronger, interval very short. f. yes. 6. 7 or 8, on the second landing we found a zig-zag crack in the wall wh. goes right through the brickwork to the other side. 7. very heavy thunder, acc. the second part of the sh.

532. Do.—Mr. A. F. S. Campbell.† 3. ab. 5.35. 6. pr. 7. 7. the panting, puffing so. of machinery worked by steam, sounding more like something rushing and passing through the air than underground; the so. acc. the sh. grad. dying away as it subsided.

533. Do.—Mrs. R. P. Pelly.† 3. 5.35. 4. as if the whole house had

been lifted and shaken bodily backwards and forwards. e. mid. f. yes. 6. 7 or 8, one bed on uncarpeted floor rolled. 7. a great noise with the sh. ending with a thud.

534. Do.—Mr. H. Dyke Acland, F.G.S.* 3. 5.34. 4. a. no. b. violent rocking motion for several secs. c. no. d. rapid increase in already strong vibr. e. pr. mid. f. no. g. N. and S. 6. < 5, many cracks in the plaster of walls, especially of those lying N. and S. 7. the first so. like a violent gust of wind, such as sometimes comes down the hills, it incr. to the noise of a traction-engine passing, then came the sh.

535. Do.—Mr. C. S. Pringle.† 3. 5.35. 4. f. yes. 5. 3 to 5 secs. 6. < 5. 7. a rumbling like a roll of wind in the chimney or traction-engine on the road.

536. Do.—Anon.* 3. 5.32 or 5.33. 4. there seemed to be three [max. of int.], the vibr. being continuous, the first sh. severe, the second very severe, and the third mild. g. N.W. to S.E. 5. 10 to 15 secs.

537. Do.—Miss L. Canning. 3. 5.36. 4. g. N.E. to S.W. 5. ab. 2 secs. 6. 7. 7. a heavy rumbling like underground thunder. b. f. imm.

538. Do.—Mrs. Hutton.* 4. bed shook up and down. 5. ab. 3 secs. 6. 7. 7. suddenly a tremendous crash. b. p. ab. 1 sec.

539. Do.—Mr. W. Hulls,* in open air, walking towards Malvern Wells. 3. 5.35. 4. vibr. of the ground plainly felt. 7. a distinct report, like two things coming into contact with one another, f. by the so. as of something coming along the road without wheels; the report seemed to come from N.E. to S.W.

540. Do.—Mr. G. Thompson.† 3. 5.38. 4. several vibra. 5. ab. 10 secs. 6. < 4. 7. steam-rollers passing, the so. c. with the sh.

541. Do.—Miss C. L. Johnstone (*Morning Post*, Dec. 18). 3. bet. 5 and 6. 4. two distinct shs. 6. 7.

542. Do.—(*Evesham Standard*, Dec. 19.) 3. 5.36. 6. 7. 7. the so. of a tremendous explosion. b. f.

543. Do.—Anon.† (*Evesham Standard*, Dec. 19). 3. 5.34. 4. the vibr. like that experienced in travelling in a springless vehicle over a rough road. 5. 15 to 20 secs. 6. 7.

544. *Great Witley*.—Mr. J. Twinberrow.† 3. ab. 5.30. 4. f. yes. g. N. to S. 6. 5. 7. a kind of waving, rolling, connected so.; the sh. came just as the so. was ceasing.

545. Do.—(*Worcester Journal*, Dec. 19.) 3. ab. 5.30. 4. g. N. and S. 5. ab. a minute. 6. < 5.

546. *Hagley*.—Rev. W. C. Gibbs.† 5. 3 or 4 secs. 6. < 5. 7. a heavy cart or dray driving close past the door. b. p. imm.

547. *Hagley Station*.—Signalman * (c. by Mr. E. Hollier). 3. 5.31 or 5.32. 4. two shs., the first stronger, interval of two or three secs. bet. them. 5. 30 or 40 secs. 6. 5.

548. *Halesowen*.—(*Bromsgrove Weekly Messenger*, Dec. 19.) 3. a few mins. after 5.30. 7. heavy cart passing. b. p.

549. Do.—(*County Express*, Stourbridge, Dec. 19.) 3. 5.40. 5. ab. 7 secs. 6. 5.

550. *Hallow*.—Rev. H. G. Pepya.† 3. ab. 5.35. 6. 7. 7 a loud rumbling noise like a heavy vehicle going along the road.

551. *Hampton Lovett*.—Mr. J. H. Dickens* (c. by Mr. W. A. Capron). 3. 5.33. 4. a. no. b. 3 vibra. in ab. 5 secs. c. yes, ab. 4 secs. d. the motion like that due to the approach and passing away of a very heavy train, it grad. incr. for 2 secs. and then as grad. died away. f. yes. 5. ab. 9 or 10 secs. 6. 5.

552. *Hanbury*.—Rev. C. W. N. Ogilvy.† 3. ab. 3.32 [sic]. 4. the bed appeared to sway sideways and then upward. 5. > 1 sec. 6. 5. 7. awakened by a loud so. like that of a train passing app. through the room from the N.E. and dying away seemingly outside towards the S.W.; the sh. was felt during the so.

553. *Hardwick Bank*.—Mr. T. B. Woodward. 3. 5.40. 4. two shs., the first ab. 6 secs., interval ab. 3 secs., the second ab. 10 secs. 6. < 5. 7. the rolling of barrels.

554. *Hartlebury*.—Mr. C. Woodward* (c. by Mr. W. A. Capron). 3. 5.34. 4. a. no. b. two [series of] vibra. ab. 10 secs. c. yes, 4 or 5 secs. e. beg. f. yes. 6. 7. 7. the cracking of brickwork. b. c. c. c. d. yes. e. c. f. no.

555. Do.—Mr. J. Clinton* (c. by Mr. W. A. Capron). 3. 5.34. 4. a. no. b. 2 vibra. c. no. f. no. 5. ab. 5 secs. 6. 6. 7. a loud roar of wind in the trees. b. p. ab. 1 sec. c. p. ab. 1 sec. d. yes. e. c. f. no.

556. Do.—Mr. J. C. Robertson.* 3. 5.35. 4. a. no. b. one series. c. no. d. yes. e. mid. f. yes. 5. ab. 20 secs. 6. < 4. 7. no.

557. *Harvington*.—Rev. J. H. Waugh.* 3. ab. 5.35. 4. a. slightly, ab. 2 secs. b. two vibra., ab. 2 secs. c. no. d. yes. e. mid. f. no. 5. ab. 4 secs. 6. 5. 7. a passing train. b. p.

558. Do.—M. Goode. 4. 7. 3 upheavals in quick succession from S.E. to N.W., and after ab. 2 secs. a noise like thunder in the distance.

559. *Henwick*.—Mr. J. Shepherd.* 3. 5.34. 4. b. one series, ab. 8 secs. c. yes, ab. 5 or 6 secs. d. yes. e. mid. f. yes. 6. 6. 7. a hard grating so. c. f. ab. 5 secs. d. yes.

560. *Hindlip*.—Rev. F. W. Wallis.† 3. ab. 5.30. 4. the sh. was of a wave-like and shaking nature combined. f. yes. 5. 10 to 15 secs. 6. 7 or 8. 7. a low rumbling so. like the passing of a heavy train. b. p. d. yes. e. c.

561. *Holt*.—M. Sale.* 3. 6.33 [sic]. 4. only one series. 5. ab. 3 secs. 6. < 5. 7. a very loud rumbling. b. c. c. c.

562. *Honeybourne*.—Mr. H. L. Jamea.* 3. ab. 5.30. 4. sh. felt by others. 7. a horse and trap going over a bridge close by, lasting ab. 10 secs. d. yes.

563. *Hunnington*.—Mrs. E. Kempson (*Birmingham Daily Gazette*, Dec. 18). 3. 5.43. 5. 3 or 4 secs. 6. < 5.

564. *Inkberrow*.—Mr. J. J. Burton.† 3. 5.30. 4. two series of vibra., with hardly any appreciable interval between them. f. no. g. pr. S.S.W. to N.N.E. 5. ab. 10 secs. 6. pr. 5. 7. no, but (according to others) a great noise.

565. Do.—Mr. J. Harris (*Worcester Herald*, Dec. 19). 4. the sensation like that of riding in a waggon on a very rough road. 5. some secs. 6. < 5. 7. the sh. acc. by a peculiar rumbling, rushing noise.

566. *Kempsey*.—Mr. C. Jervia 3. 5.35. 4. a. yes b. nearly vert. vibra c. yes 5. ab. 4 secs. 6. 7. 7. the approach, passage and receding of an extremely heavy battery of artillery along the high road at a great speed. b. p. ab. 2 secs. c. p.

567. Do.—Mrs. Chavasse.* 3. ab. 5.35. 4. an upheaval of the bed, wh. distinctly rocked 3 times 5. 5 secs. 6. 7. 7. a rumbling so. from the S.W., a couple of secs. bet. the so. and the sh.

568. *Kidderminster*.—Mr. J. R. Goodwin. 3. 5.35. 4. 3 or more vibra. of an undulating nature. c. yes f. yes g. S.E. to N.W. (S. to N., according to others in the same house). 5. ab. 5 or more secs. 6. < 5. 7. a rumbling so., like a gust of high wind, acc. the sh., and faded away as the crockery stopped rattling.

569. Do.—Mr. A. Williams.* 3. 5.35. 5. ab. 20 secs. 7. a very deep so. of a clattering nature, as though huge pieces of rock were settling together.

570. Do.—Mr. J. V. Corvesor.* 3. 5.35. 4. 4 distinct oscillations. 5. ab. 4 secs. 6. 6, in the obs.'s room there is a gas pendant balanced by weights or chains, the sh. caused the weights to swing fully 6 inches, and they continued swinging for over half an hour. 7. no.

571. Do.—Mr. E. A. Bouët. 3. ab. 5.25. 7. a continuation for some secs. of the great noise a heavy substance would make in falling on a floor.

572. Do.—Mr. A. Cotton. 3. 5.35. 6. < 5. 7. a very heavy vehicle passing, or a rushing like a strong gust of wind.

573. Do.—(*Kidderminster Sun*, Dec. 19.) 3. 5.32. 4. the sensation precisely the same as when the brakes are suddenly applied to a fast train. 6. 7, the clock at St. George's Church stopped at 5.32. 7. a train passing through a tunnel.

574. Do.—(*Daily Chronicle*, Dec. 18.) 4. two distinct shs. 6. three houses were damaged [? C. D.—"There appears to have been no actual damage in the Kidderminster district traceable to the earthquake," *Birmingham Daily Post*, Dec. 18]. 7. a loud report.

575. Do.—Anon.* (*Kidderminster Sun*, Dec. 19). 3. ab. 5.33. 4. a slight shake of the window, wh. grad. got more violent as if a steam-roller were passing; when the shaking of the window was at its loudest, there were two distinct shs. f. by a slight tremor. 5. ab. 7 or 8 secs.

576. *King's Norton*.—Mr. W. S. Pritchett.† 3. 5.32. 4. the bed was shaken from side to side with a quick regular motion. 5. 15 secs. 6. 5. 7. no.

577. Do.—Anon.† (*Daily Argus*, Birmingham, Dec. 17). 3. 5.32. 5. ab. 30 secs. 6. 5. 7. a loud noise as though some one were throwing himself violently against the door; the noise f. by the sh.

578. *Kington*.—Rev. W. J. Holden.† 3. ab. 5.35. 4. b. at least 2 or 3 vibra., 5 or 6 secs. c. yes, ab. 10 secs. e. beg. f. yes. 6. 5. 7. a cart driven rapidly past; the so. p. the sh.

579. *Knighton-on-Teme*.—Rev. W. B. Glennie.† 3. ab. 5.37. 4. the sh. grad. incr. to violence and ended suddenly. f. yes. 5. ab. 4 secs. 6. 7? 7. no.

580. *Knightwick*.—Rev. J. B. Wilson.† 3. 5.35. 4. f. yes. 5. ab. 2 or 2½ secs. 6. 7 or 8, in the cellar two bottles of brandy standing on a

shelf 4 feet high were thrown a distance of 4 ft. 6 ins. in a N.W. direction; the tall tapering spire of the church was damaged, ab. 2 feet of stone-work imm. beneath the weather-cock being shaken off, the falling stone doing much harm to the roof of nave and porch. 7. no.

Mr. H. Dyke Acland, F.G.S., has kindly given me the following additional information obtained from the builder who repaired the church.

"(1) The pinnacles round the base of the spire were apparently lifted bodily, just as if a severe blow had been given to the tower from below. The stones were lifted bodily and replaced in their original position. (2) The finials, at least seven out of the eight, though dowelled to the extent of 4 or 5 inches were thrown right off: they all fell to the N.W."

581. *Kyre Lodge*.—(c. by Rev. Preb. F. C. Baldwyn-Childe.) 3. 5.30. 4, 7. a rumble like a carriage going along the road: then a sh. like two or three doors banging with oscillation: then a slighter rumble like mice running on the floor above.

582. *Kyre Park*.—(c. by Rev. Preb. F. C. Baldwyn-Childe.) 4. the movement slight. 7. a so. like an explosion twice over.

583. *Leigh Sinton*.—E. Yarnold.* 3. 5.34. 4. a continuous shaking. 5. 10 or 12 secs. 6. pr. 7. 7. a rushing mighty wind. b. p. $\frac{1}{2}$ sec.

584. *Little Comberton*.—Rev. E. S. Lowndes† (c. by Mr. W. Pearce). 4. f. yea. 6. 5. 7. wind rushing by.

585. *Littleton*.—(c. by Rev. F. S. Taylor.) 3. ab. 5.40. 6. 6.

586. *Malvern Link*.—Miss K. Shirley.† 3. 5.34 or 5.35. 4. two series of vibra. [the second app. stronger], interval ab. 3 or 4 secs. but not very distinct. 5. 12 to 15 secs. 6. 6? in the store-room jam-pots were found afterwards half off their shelves. 7. a rush, a roar and a crash. b. p. c. p. ab. 3 or 4 secs.

587. Do.—Mr. J. J. Towndrow.* 3. 5.32. 4. c. yea. g. N.E. to S.W. 5. 10 secs. 6. < 5. 7. heavy thunder in the distance, coming nearer and nearer. b. p. 4 or 6 secs.

588. Do.—Mr. M. Weston. 3. 5.31. 4. one series. 6. < 5. 7. almost like thunder; the so. p. the sh. entirely.

589. Do.—(c. by Mr. J. G. R. Powell.) 4. the bed lifted, and then swayed from side to side. 7. sh. f. by a grinding or crunching noise.

590. *Malvern Wells*.—Mr. W. B. Burrow.* 3. 5.34. 4. a strong vibr. such as might have been caused by a man grasping the brass-work at the foot of the bed and shaking it from side to side. f. no. 6. 5. 7. an unusual low rumbling noise, like a heavy cart passing along the road from S. to N., rapidly increasing to a roar and crash; the vibra. acc. the crashing noise wh. sounded like the sudden collapse of a large building. b. p. e. c. The noise and sh. lasted 10-15 secs.

591. Do.—Mr. H. A. Acworth.* 3. 5.32 $\frac{1}{2}$. 4. Two sha., the second pr. the stronger, interval between them ab. 8 or 10 secs., the second sh. lasted 5 or 6 secs. 6. < 5; of all the great number of fragile ornaments (including two alabaster vases 3 feet high on a shelf of the drawing-room overmantel) scattered about the house, none was upset. 7. a harsh growl. "I thought I heard the noise in the interval between the sha."

592. Do.—Miss L. Clarke.* 3. 5.35. 4. one sh. d. yea. 6. < 5. 7. the approach of a traction-engine. d. yes; the so. entirely p. the sh.

593. *Newnham Bridge*.—Mr. O. Parsona. 3. 5.28. 4. c. yes. d. yes, one max. e. beg. 5. ab. 15 secs. 6. 5. 7. a train passing sharply by without stopping.

594. *Do*.—Mr. J. J. Greaves. 3. 5.32. 4. two vibra., as though the bed had a strong push, pull-back and push again. 5. ab. 6 secs. 6. < 4. 7. a train going over a wooden bridge. b. p. ab. 2 secs.

595. *Norton*.—(c. by Rev. W. C. Boulter.) 6. 6 or 7.

596. *North Malvern*.—Mr. W. Graham.* 3. 5.30. 4. f. yes. 6. < 5. 7. as if the wind had unroofed some part of the house.

597. *Norton-by-Bredon*.—(*Tewkesbury Register*, Dec. 19.) 6. a small clock standing by a bedside fell to the floor.

598. *Nummery Farm*.—Mr. G. Pitcher.* 3. 5.32. 4. a. yes, ab. 4 secs. b. two series of vibra., ab. 4 secs [each], interval of 2 secs. bet. them. c. yes, ab. 8 secs. e. end. f. no. 5. 22 secs. 6. 5. 7. a distant rumbling. b. p. ab. 1 sec. c. p. ab. 1 sec. d. yes. e. p. ab. $\frac{1}{2}$ sec. f. yes, more like the so. of rough wind.

599. *Offenham*.—Rev. W. J. Bristow.† 3. ab. 5.30. 4. f. yes. 6. < 7, several bricks have fallen down three chimneys wh. had been repaired earlier in the year. 7. a luggage-train.

600. *Oldbury Grange*.—Mr. A. C. McTavish. 3. 5.34. 4. two distinct sha., the first the stronger, each ab. 2 secs.; during the interval, ab. 1 or 2 secs., vibra. still felt. f. yes. 6. < 5. 7. a heavy train approaching. b. p. ab. 2 secs. c. c.

601. *Pendock*.—(*Tewkesbury Register*, Dec. 19.) Obs. walking. 4. the ground shook. 7. a loud report and then a rumbling noise.

602. *Do*.—(*Worcester Journal*, Dec. 19.) 5. several secs. 6. 7.

603. *Pershore*.—Mr. W. Pearce.* 3. ab. 5.35. 4. a shivering motion f. after a few secs. by a sharper shake. 6. pr. 7, mortar dislodged from chimney. 7. distant thunder or rolling an empty barrel in a cellar.

604. *Do*.—Anon. 4. the first movement was short and then, after a scarcely perceptible pause, the vibr. was more intense. 5. a few secs. 6. < 5. 7. a long rumbling noise acc. the sh.

605. *Do*.—(*Evesham Journal*, Dec. 19.) 3. 5.32. 5. 2 or 3 secs. 6. 7. 7. a rumbling noise.

606. *Pirton*.—Anon.* 3. 5.40. 4. a. yes, ab. 2 secs. b. 3 vibra. c. yes. d. yes. e. mid. f. no. 5. 5 or 6 secs. 6. 6. 7. heavy waggon going over stones acc. by heavy claps as of large doors. b. f. 1 sec. c. p. 2 or 3 secs. e. p. 2 secs. f. seemed to cease.

607. *Powick*.—Rev. A. Bond.† 3. 5.35. 4. a. tremor with heavy rumbling, ab. 10 secs. b. the tremor brought to an abrupt termination by a sort of jerk W. and E., 2 secs. c. a gentle tremor, ab. 30 secs. f. no. 6. 6 or 7, the drawing-room (pendulum) clock stopped at 5.40 (it was 5 mins. fast), also it slid eastwards along the smooth top of the cabinet where it had stood central previously. 7. a heavy rumbling or grating as of a cart crossing the room; the end of the so. c. with the prin. vibra. d. no. f. no.

608. *Redditch*.—Dr. W. H. Page.* 3. 5.32. 4. one distinct sh. 5. 2 or 3 secs. 7. a heavy traction-engine passing. c. f. 3 or 4 secs.

609. *Do*.—(*Worcester Herald*, Dec. 19.) 3. ab. 5.30. 6. pr. 7.

610. *Rednal*.—Mrs. H. M. Fryer.† 3. 5.35. 4. the house swayed

violently to and fro, each oscillation becoming weaker until as it passed away it was only a tremor. 6. there is hardly a wall, ceiling or cornice that is not cracked.

611. *Rockford*.—Rev. J. Tomson.† 3. 5.35. 4. first sensation a lifting motion, ab. 1 sec. c. a strong trem. mot., > 2 secs. f. yes. g. S.W. to N.E. 5. > 3 secs. 6. 7. 7. no, but another obs. (who was awake) heard a so. like distant thunder before the sh. came.

612. *Rock*.—Rev. F. A. Reiss.† 3. 5.35. 4. a. yes, ab. 5 secs. b. one series, ab. 10 secs. c. no. d. grad. incr. in int. and ended with violence. e. end. f. yes. 5. ab. 15 secs. 6. < 5. 7. a continuous rumbling like the rolling of barrels getting grad. nearer. b. p. ab. 5 or 6 secs. c. c. d. f. grad. louder till it seemed to end in an explosion. e. c.

613. *Rouse Lench*.—Anon.* 3. 5.30. 4. the bed swayed from side to side with an undulating movement. 6. 5. 7. a waggon letting down a quantity of stones; the so. c. with the sh.

614. *Shipston-on-Stour*.—(*Banbury Guardian*, Dec. 24.) 6. 7?

615. *Shrawley*.—Rev. W. F. Vernon.† 3. 5.30. 4. f. yes. 5. 3 secs. 6. 5.

616. *Stanford-on-Teme*.—Rev. E. H. Oldham.* 3. 5.35. 4. a. yes, a few secs. d. yes. e. mid. g. E. to W. 5. ab. 10 secs. 6. 6. 7. distant thunder. d. yes.

617. *Stirchley*.—Mr. F. L. Wrightson.† 3. 5.30. 4. the bed shook from end to end with very regular oscillations, wh. were acc. by a trem. mot. g. N. to S. 5. 10 to 12 secs. 6. 6. 7. a dull roaring noise as of a train passing under the house.

618. *Stirchley Street Station*.—Mr. A. Pearce.* 3. 5.32. 4. two distinct sh., the second much weaker and of shorter duration. c. yes. f. yes. 5. ab. 20 secs. 6. 5. 7. a peculiar rumbling noise. b. p. a very few secs. c. c.

619. *Stoke Prior*.—Mr. C. F. Price. 3. 5.30. 4. 3 vibra. 5. 5 or 6 secs. 6. 5. 7. no.

620. *Stoke Works Station*.—Mr. A. W. Rich.* 3. 5.31 to 5.32. 4. a. yes, 10 secs. b. two max. of int., ab. 50 secs. f. yes. 5. 60 secs. 6. < 5. 7. the starting of a heavy goods-train. b. p. ab. 3 secs. c. c. e. c. f. yes.

621. *Stone*.—Rev. J. M. Donne. 3. 5.33. 4. sh. felt. 7. a few secs. later a noise as of a 40-lb. shot falling on the floor of the room below.

622. *Stoulton*.—Rev. H. Kingsford.* 3. ab. 5.35. 4. a. yes, ab. 4 secs. b. 4 or 5 prin. vibra, each taking ab. $1\frac{1}{2}$ to 2 secs. c. yes, 2 or 3 secs. d. the vibra. incr. two or three times and then died away. e. ab. mid. f. yes. g. W. to E. 6. pr. or nearly 8, one chimney in a farm-house at Windmill Hill in the parish was cracked. 7. a sharp so. f. by a rumbling wh. rose and fell two or three times and then died away to the E. b. p. 3 or 4 secs. c. f. 2 or 3 secs. e. p.

623. *Stourbridge*.—Mr. H. Bryan* (a policeman on duty standing beside the *County Express* office). 3. 5.33. 4. two series, the second stronger, interval ab. 4 secs. 6. three or four courses of bricks were thrown off a chimney on the *County Express* office. 7. distant thunder; the so. coincided with the second part of the sh. and continued after it ab. 3 or 4 secs.

624. *Do*.—Anon.* 3. 5.32. 4, 7. a loud report like an explosion, and the house seemed to tilt over slightly; following this almost imm. a loud

rumbling so. (as if an enormous traction-engine was driven furiously past), acc. by a great vibr.; before the tremor had spent itself, there came a second "explosion," f. by a similar vibr. quite as violent as the first and in every way resembling it; with the vibr. it seemed as if there was a sort of "whish" as the supposititious engine swept past. g. E. to W. 5. 10 secs. 6. \leftarrow 5.

625. Do.—Mr. E. Beresford. 3. 5.30. 6. 5. 7. a rumble as of a heavily-laden cart before the sh.; it seemed to come from the S.

626. Do.—Anon.* 3. ab. 5.30. 6. 5. 7. a noise like a cart approaching, then getting louder like a traction-engine with caravans, then a rushing so. like a whirlwind with wh. the sh. came.

627. Do.—(*County Express*, Stourbridge, Dec. 19.) 6. a chimney-pot and some bricks fell at the offices of the *County Express* in High Street.

628. *Stourfort*.—Mr. C. H. Pountney* (walking). 3. 5.33. 4. the houses seemed to sway. 6. \leftarrow 5. 7. a noise like that of snow falling off the house-tops, getting grad. louder, and then a rush like wind and a crash as if some buildings had fallen at the back of the street; in a few secs. the houses seemed to sway.

629. *Suckley*.—Miss M. G. Kane. 3. 5.32. 6. \leftarrow 6. 7. loud thunder, becoming grad. louder. b. p. c. p.

630. *Tardebigge*.—(*Worcester Herald*, Dec. 19.) A terrific crash f. by a very perceptible trembling.

631. *Tenbury*.—Mr. H. I. Eliot. 3. 5.40. 4. two distinct sha. felt by others in the house. 5. ab. 10 secs. 6. \leftarrow 4. 7. no.

632. Do.—Mrs. Hewitt.† 3. 5.30. 4. three series, divided by intervals of a sec. each, the first the strongest and longest. f. no. 5. \rightarrow 20 secs. 6. \leftarrow 5. 7. no, but others describe it as resembling a traction-engine moving quickly.

633. *Upton-on-Severn*.—Mr. E. Twycross.† 3. 5.31½ to 5.32. 4. the sh. was as if some one had taken hold of the two posts of the bed and violently shaken it. f. no. 5. pr. 6 secs. 6. pr. 7, on the top floor of the house, four bottles on a toilet table were thrown down, three at one end and one at the other; the necks of all the bottles fell towards the S.W. 7. a rushing so. as of a departing wind after the sh.

634. Do.—Mr. E. Tennant. 3. 5.40. 4. a continuous vibr. acc. by distinct trem. mot. 5. 10 to 15 secs. 6. 5. 7. such as is made by a traction-engine, only much louder, the beg. like thunder. b. p. ab. 3 secs. c. f. ab. 2 secs.

635. Do.—Mr. G. R. Clarke.* 3. ab. 5.35. 4, 7. suddenly a noise like a steam-tug violently blowing off steam, but it was soon too loud for that; the bed and every article in the room shaken with a great vibr.

636. Do.—Anon.† (*Ledbury Free Press*, Dec. 22). 3. 5.35. 4. the bed rocked to and fro. g. E. and W. 6. \leftarrow 6. 7. the rushing of a train over a bridge.

637. *Upton Warren*.—Rev. W. P. Vincent.† 3. 5.30. 4. a. yes, ab. 3 secs. b. two max., second stronger, with 8 secs. interval. c. yes, ab. 8 secs. 5. 20 to 30 secs. 6. \leftarrow 5. 7. a most unusual noise, becoming louder before each sh. and dying away after each. b. c. c. f. ab. 8 secs. e. c. f. became rougher.

638. *Webbheath*.—H. and M. Sedley. 3. 5.30. 5. 6 secs. 6. < 4. 7. a noise like something heavy fallen. b. p.

639. *West Malvern*.—Mr. W. J. Smyth. 3. 5.34. 4. f. yes. 5. ab. 20 secs. 6. < 5. 7. a combination of wind and landslide; the so. heard before and during the sh.

640. Do.—(c. by Mr. H. Dyke Acland, F.G.S.) 6. 8, at St. James's House, walls in archways were cracked.

641. *Westwood Park*.—Anon.† 3. 5.33. 4. f. yes. g. a clock facing due E. stopped at 5.35. 6. 6. 7. thunder.

642. *Wichenford*.—(*Worcester Herald*, Dec. 19.) 3. 5.30. 6. < 4. 7. the sh. acc. by a loud report.

643. *Wick*.—Mr. A. R. Hudson * (c. by Mr. W. Pearce). 3. 5.32½. 4. two series, the first ab. 4 secs.; interval of app. perfect quiet, 5 or 6 secs.; the second and much more intense series, 6 or 7 secs. 6. first series 4, second series 6. 7. with the second sh. there was a great noise like a tornado through a forest of trees. b. p. that of second sh. c. c.

644. *Woollashill*.—Mr. F. Davis (*Evesham Journal*, Dec. 19). 3. 5.35. 5. ab. 30 secs. 6. < 4. 7. a slight rumbling noise like an approaching train or sudden gust of wind, wh. increased till it became like a train passing underneath the room.

645. *Worcester*.—(*Nature*, vol. 55, 1896, pp. 178-179; *Worcester Herald*, Dec. 19.) 6. 7. The clock at All Saints' Church stopped; in one house a lamp was upset, in St. John's Street a clock was thrown off the mantelpiece, in Ombersley Road a pile of books was thrown from a shelf, at the Falcon Inn (Broad Street) a barrel of stout was rolled across the floor of a room in wh. it was lying on its side; a strong fixed wash-hand basin in a lavatory was split to pieces; tiles were shaken off the roofs of several houses, and a chimney was thrown down in Ombersley Road; the Cathedral suffered no damage.

646. Do.—Mr. J. L. Bozward (*Nature*, vol. 55, 1896, p. 178). 3. 5.31. 4. two sha, with a bare interval bet., they consisted of vibra. too rapid to count. g. app. N. to S. 5. bet. 4 and 5 secs. 6. 7. 7. the sha. were p. by a roar as of thunder.

647. Do.—Mr. C. Rea. 3. ab. 5.32. 4. the bed rocked from side to side. g. S. to N. 5. < 30 secs. 6. < 6. 7. a strange rushing so. like a concentrated burr burr, and somewhat resembling the noise heard occasionally on a boisterous windy day when one is in a narrow gully or a mountain's side wh. directly faces the point from wh. the wind proceeds; almost imm. the sh. began; as the sh. passed away, there was a noise resembling the passing of a heavy traction-engine.

648. Do.—Mrs. Newth.† 3. 5.30. 5. ab. 2 secs. 7. a rumbling noise acc. the vibr.

649. Do.—Miss M. E. Webster.* 3. 4.35-4.38 [*sic*]. 4. the house swayed most distinctly to the W. 5. 3 to 4 secs. 6. < 5. 7. so. heard. c. f.

650. Do.—Anon.† 4. b. 3 distinct waves. c. yes. 6. < 4. 7. a loud rumbling noise like a strong wind.

651. Do.—Mr. H. Oram (*Worcester Herald*, Dec. 19). 3. 5.30. 5. ab. 30 secs. 6. pr. 7. 7. a rumbling so. was heard after the sh. but not before.

652. Do.—Mr. J. Westby (*Evesham Standard*, Dec. 19). 3. ab. 5.30.
 4. The motion seemed to proceed from the N. or N.E. with a few slow movements, then a series of quicker wave-movements; a slight pause, then slower movements in a S. or S.W. direction. 5. ab. 10 secs.
 653. Do.—(*Standard*, Dec. 18.) 4. g. N. to S. 7. the first indication was given by a loud report, f. by subterranean rumbling.
 654. Do.—Miss Corbett (*Birmingham Daily Post*, Dec. 18). 3. 5.32.
 655. Wychbold.—(*Bromsgrove Weekly Messenger*, Dec. 19.) 3. shortly before 5.40. 6. pr. 7. 7. a low rumbling so. b. p.
 656. Yardley.—Mr. S. K. Thornley.† 3. 5.34. 4. f. no. g. N.W. to S.E.

SHROPSHIRE

657. Albrighton.—(*Wellington Journal*, Dec. 19.) 6. < 4.
 658. All Stretton.—Mr. E. S. Cobbold. 3. 5.33. a.m. 4. a number of vibrations as if caused by an unnaturally heavy dray or train passing along the road. f. yes. g. E. and W. 7. no (though heard by other observers).
 659. Ashford Carbonell.—Rev. J. S. Tanner.† 3. 5.33 or 5.34. 4. the house seemed to rock like a boat on a wave. g. W. to E. 6. < 5. 7. as if furniture were being moved about in the room above (according to other observers, like a steam-roller or traction-engine passing).
 660. Astley Abbots.—Rev. J. C. B. W. Warwick (*Bridgnorth Journal*, Dec. 19). 3. ab. 5.35. 4. f. yes. g. W. to E. or S.W. to N.E. 5. 2 to 4 secs. 6. 5. 7. a rumbling noise.
 661. Aston Botterell.—Mr. J. Jones (*Bridgnorth Journal*, Dec. 19). 3. ab. 5.30. 4. 3 shs. 5. ab. 4 or 5 secs. 7. a rumbling noise f. by the shs.
 662. Baschurch.—(c. by Rev. T. J. Rider.) 6. pr. 5. 7. no.
 663. Bedstone.—Rev. J. H. Brown.† 3. ab. 5.35. 4. g. N. to S. 6. 5. 7. a rumbling so. before the sh.
 664. Bettws.—Anon.† 3. 5.30. 4. a trem. mot., lasting ab. 6 secs., ending with a jerk. g. N. to S. or N.E. to S.W. 6. < 5. 7. a very heavy blast of wind, the end of wh. f. the beg. of the trem. mot. by a sec. or so. Total observed duration of so. and sh. ab. 20 secs.
 665. Billingsley.—Rev. J. L. Williams. 3. ab. 5.30. 4. the vibra. grad. incr. in int. e. mid. f. yes. 6. 5 or 6. 7. a hurricane. b. p. d. yes.
 666. Bishop's Castle.—Mr. R. W. Brown.† 3. 5.35. 4. only one series felt (but, according to others, there were two series, the second stronger), the bed rocking three times with a pleasant, even, undulating motion. g. N. and S.; in another house, the head of a bed lying N. and S. bumped against the wall. 5. 4 or 5 secs. 6. pr. 7. 7. a loud rumbling muffled so. wh. seemed to roll up the street. b. p. ab. 1 sec. c. f. ab. 5 secs. The so. seemed to cease during the vibra. and imm. afterwards to continue rolling up the street.
 667. Do.—Mr. E. Griffiths. 3. 5.35. 4. b. one sh. as if a weight had been hurled against the house. c. yes, ab. 4 secs. 5. ab. 5 secs. 6. pr. 5.

7. a so. like that of a distant explosion c. with the sh., a rumbling so. after for ab. 4 secs. [*i.e.* coinciding with the trem. mot.], like distant thunder dying away apparently in the S.W.

668. *Bitterley*.—Mr. W. R. Cannon.† 3. ab. 5.40. 4. two distinct shs., the first more severe, interval bet. shs. pr. < a sec., duration of second sh. ab. 1 or 1½ secs. g. N. to S.

669. *Bridgnorth*.—Mr. C. Cook. 3. 5.35. 7. a large traction-engine passing along the street and then over a bridge close to the house, at wh. instant the house was shaken violently.

670. Do.—(*Bridgnorth Journal*, Dec. 19.) 3. 5.35. 6. 5. 7. a rushing so. as of a violent hurricane or a heavily-laden train passing through a tunnel.

671. Do., ab. 2 miles N. of.—(c. by Rev. T. Mayo.) The mail-cart driver felt the sh. and his horse stopped.

672. *Bromfield*.—Rev. W. Selwyn. 3. ab. 5.30. 6. < 5. 7. a rumbling noise, like a traction-engine coming down the road, f. by a shaking of the bed to and fro.

673. *Broseley*.—Mr. D. L. Prestage* (c. by Mr. E. S. Cobbold). 3. 5.35. 4. 6 distinct horizontal shakes of ab. equal int. 5. ab. 4 secs. 6. 5. 7. the approach of a steam-roller or traction-engine, the so. p. the sh. by ab. 5 secs. and incr. in int. until the first shake was felt, after wh. it was no longer heard.

674. Do.—Mr. H. Stuart* (c. by Mr. E. S. Cobbold). 3. 5.35. 4. one series of vibra. of the same int. f. yes. 5. ab. 3 or 4 secs. 6. 5. 7. an explosion at a distance. b. c. ab. c. c. d. no.

675. Do.—Mr. G. H. Maw† (c. by Mr. E. S. Cobbold). 3. 5.35. 6. < 5. 7. no.

676. *Burford*.—Mr. W. I. Davis.* 3. ab. 5.32. 4. one series of vibra. 5. 4 or 5 secs. 6. < 4. 7. heavy furniture upset in the drawing-room below. b. c. c. f.

677. *Chelmarsh*.—Rev. R. T. Seddon. 4. two shs., the first stronger. 7. the so. p. the sh.

678. *Cheswardine*.—Rev. J. E. Hughes† 3. 5.35. 4. one series of vibra. d. yes. 6. 5.

679. *Chetwynd*.—Rev. C. R. Gordon, D.D., F.G.S.* 3. 5.33. 4. a trem. mot., in the mid. of wh. the bed swayed from N. to S. f. yes. 5. ab. 12 or 15 secs. 6. 5. 7. a hissing so. like that of rushing wind before the sh.; during the sh. a rumbling noise like several traction-engines passing.

680. *Chetwynd Park*.—Mrs. Borough† 3. ab. 5.40. 4. the bed swayed. 5. ab. 15 secs. 6. 5. 7. something like a very violent storm of wind, the so. pr. over before the sh. began.

681. *Chirbury*.—Rev. J. Burd. 3. 6.35 [*sic*]. 4. f. yes. 6. 5.

682. *Chirk Bank*.—Mr. J. Price* (c. by Mr. J. M. Clements). 3. ab. 5.34. 4. a violent vibration. g. ab. E. and W. 5. ab. 2 or 3 secs. 6. pr. 5.

683. *Cleobury Mortimer*.—Mr. J. Davis† 3. 5.27. 4. one continuous series of vibra., uniformly strong throughout. f. no. 5. 5 to 10 secs. 6. 5. 7. as if people were jumping up and down the room overhead, but louder.

684. Do.—Miss M. E. Swaine.† 4. the room seemed to sway and rock. f. no. 6. 5.

685. *Cockshutt*.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 3. ab. 5. 4. sh. felt.

686. *Condover*.—Mrs. T. Auden.* 3. 5.34 or 5.35. 4. the vibra. incr. in int., the principal one being in the middle of the series. g. N. to S. 5. ab. 20 secs. 6. < 4. 7. the rapid passing of a heavy traction-engine, there was also an explosive so. as if the engine had exploded; the so. died away as the shaking began.

687. *Court of Hill*.—Mr. A. Hill-Lowe. 3. ab. 5.35. 4. two sha., the first stronger, interval bet. them 3 or 4 secs. 6. < 5. 7. an explosion like blasting, and the bed heaved up; in ab. 3 or 4 secs. another loud explosion and shake, f. by a rumbling so.

688. *Culmington*.—Rev. D. E. Holland. 3. bet. 5.40 and 5.45. 4. app. two sha. 6. < 4. 7. a traction-engine passing.

689. *Diddlebury*.—Rev. S. Scarlett Smith. 3. bet. 5.30 and 5.45. 4. two sha., the second stronger. f. yes. 5. 40 secs.? 6. < 5. 7. a great noise like unloading coal. b. f. $\frac{1}{2}$ sec. c. f. a few secs. d. ab. the same int. throughout.

690. *Donnington Wood*.—Mr. J. W. Briggs† 3. 5.34. 4. five series of vibra. such as are caused by a steam-roller passing or a heavy traction-engine with load, the third series vertical, the rest lateral. 5. $7\frac{1}{2}$ secs. 6. 5. 7. a dull noise; the vibra. seemed to be a continuation of the so.

691. *Edgton*.—Rev. M. Jones† 3. ab. 5.30. 4. one continuous series of vibra. f. yes. 5. 2 or 3 secs. 6. 5. 7. a steam-roller passing by, only at a quicker pace than usual, the so. dying hard in the distance towards the E.

692. *Ellesmere*.—Mr. F. S. Knapp† (*Oswestry and Border Counties Advertiser*, Dec. 23.) 3. 5.36. 4. the bedstead uplifted and moved out of place. 5. ab. 30 secs. 6. 5. 7. the sh. acc. by a rumbling noise.

693. Do.—Mr. H. Pierce* (*Oswestry and Border Counties Advertiser*, Dec. 23.) 3. ab. 5.35. 4. a rocking motion f. by a lifting of the bed.

694. Do.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 6. no damage reported, except that a wall in Scotland Street was slightly cracked. 7. the noise made by a wheelbarrow.

695. Do.—(*Montgomery County Times*, Welshpool, Dec. 19.) 3. ab. 5.35. 4. two sha. felt. 6. 5.

696. *Frankton*.—Mr. W. Reynolds (c. by Mr. C. S. Dennis). 3. ab. 5.30. 4. only one series felt. e. mid. f. yes. 5. 5 to 6 secs. 6. 5. 7. the passing of a very heavy waggon loaded. c. c. ab.

697. *Grimshill*.—Mr. E. Elamere. 3. 5.33. 4. at first a concussion as if some one had knocked violently against the bed, f. imm. by a succession of tremulous movements. f. no. g. N. and S. 5. ab. 8 secs. 6. 5. 7. the concussion acc. by a momentary so. like an explosion.

698. *Habberley*.—Mr. J. Beddewa. 3. ab. 5.40. 4. two series of vibra. 5. first series ab. 3 secs., second ab. 4 secs. 6. 5. 7. thunder. b. c. d. yes. e. f. ab. 4 secs. f. yes.

699. *Hadnall*.—Mr. K. Wilson* (c. by Mr. J. Bedson). 3. 5.25. 4.

two series of vibra., duration of interval the same as that of either series.
6. 5. 7. a very strong wind: the so. ended before or as the sh. began.

700. *Harlescott*.—Mr. E. Parry. 3. 5.36. 4. one series of vibra. 5. ab. 4 or 5 secs. 6. < 4.

701. *Hope Bagot*.—Rev. C. B. Greatrex. 3. 5.35. 4. e. end. f. no. 5. 4 secs. 6. 7 or 8, pieces of brick and plaster came down some of the chimneys and three tiles off the roof. 7. a loud rumbling noise p. the sh. by several secs.; it seemed to travel from N.W.

702. *Hopesay*.—J. E. C. Barker.† 3. 5.35. 4. several vibra. of equal int. wh. seemed to stop suddenly. f. no. 5. several secs. 6. 5. 7. a very loud rumbling, something like thunder or a heavy train going through a tunnel. b. p. The so. seemed to be coming gradually nearer from the S. or S.W. and ended suddenly with a kind of crash just as the sh. began.

703. *Hopton Castle*.—Rev. E. D. Elton.† 3. 5.25. 4. b. one series. c. yes, ab. 3 secs. d. yes. e. mid. f. yes. 6. 6. 7. as if a chimney-stack had fallen through the roof. d. yes.

704. *Horsehay*.—Mr. L. S. Hollings.† 3. ab. 5.35. 4. a reciprocating sliding motion, slow at first, but increasing in speed as it diminished in violence, ending in a kind of tremor or shiver. f. no. g. W. by S. and E. by N. 5. ab. 10 secs. 6. 5. 7. an impression of a so. like the muffled fall of a great mass of earth and a grinding rubbing so. just before the obs. was thoroughly awake.

705. *Hughley*.—Rev. E. Collett.* 3. 5.28. 4. a. yes, 2 or 3 secs. b. one or two oscillations, 2 secs. c. yes, ab. 2 or 3 secs. d. yes. g. S.S.W. to N.N.E. 6. 5. 7. a railway-train passing over a girder bridge with a wooden floor. b. p. ab. 2 secs. c. f. ab. 2 secs. d. the so. incr. as if coming from a distance, passed over and then died away. e. c.

706. *Ifton Heath*.—A. Phillips* (c. by Mr. J. M. Clements). 3. 5.35. 6. 7? 7. a roaring noise. b. p.

707. *Ironbridge*.—Mr. T. Law Webb.† 3. 5.35. 4. awakened pr. by first sh., in 2 or 3 secs. a bump wh. seemed to heave the floor, acc. and f. by a powerful oscillation wh. rocked the bed to and fro. 5. 4 or 5 secs. 6. 5. 7. an indistinct rumbling so. heard until the end of the oscillations.

708. *Kilsall*.—Mr. D. Jones.† 4. one series of vibra. 5. ab. 3 secs. 6. < 4.

709. *Kingsland*.—Mrs. Forman.† 3. 5.35. 4. bed shaken to and fro ab. 6 or 8 times, like a very shaky railway carriage. 5. ab. 3. secs. 7. (according to another obs.) a noise like a heavy cart passing; the so. ended before the sh. began.

710. *Kinlet*.—Rev. J. J. Casa. 3. 5.30. 4. a violent shaking from W. to E. 7. the noise heard by another obs.

711. *Knowle Sands*.—Lt.-Col. Owen Jones.† 3. 5.35. 4. one series of vibra., a rolling and upheaving motion. 5. 3 or 4 secs. 6. < 5. 7. a cart-load of bricks upset just outside the house. c. f. 2 or 3 secs.

712. *Little Drayton*.—Anon.† 3. 5.30. 4. the bed swayed to and fro 4 or 5 times, the last time most severely. 5. 12 secs. 6. 5. 7. thunder or a heavy vehicle passing.

713. *Little Wenlock*.—Rev. Canon T. Nash.* 3. 5.26. 6. 5. 7. distant thunder. b. p. c. p.

714. *Longnor*.—Rev. J. Edwardes. 3. 5.34. 5. 10 or 12 secs. 6. < 4. 7. awakened by a noise as of a rushing train, wh. died away suddenly, and after an interval of 3 or 4 secs. the sh. was felt.

715. *Ludlow*.—Mr. C. Fortey † (c. by Mr. E. S. Cobbold). 3. 5.40. 5. > 10 to 15 secs. 6. < 5.

716. Do.—(*Leominster News*, Dec. 18). 3. 5.32. 5. ab. 3 secs. 6. no damage worth mentioning. 7. a rumbling noise, wh. grew louder and louder, and then a severe shaking of the earth.

717. *Madeley*.—Mr. J. Randall † (c. by Mr. E. S. Cobbold). 3. just after 5.30. 4. two max. of int. 6. < 5. 7. (according to another obs.) the letting off of steam.

718. Do.—Miss F. Yate. 3. 5.30. 4. a. no. b. 7 or 8 vibra, ab. the same int. throughout. f. yes. 5. ab. 10 secs. 6. 5. 7. (according to other observers) thunder or a traction-engine passing.

719. *Mainstone*.—Rev. W. E. Glenn.* 4. as if raised by two waves without, as it were, any trough; each wave f. by two or three jerks. 5. ab. 8 secs. 6. < 5. 7. a laden dray lumbering along, or a fairly heavy train running in a cutting or through a tunnel.

720. *Market Drayton*.—Mr. J. C. Clay.† 3. 5.31. 4. two distinct shs, separated by a few secs, the first much the stronger, lasting perhaps 15 secs, the second of shorter duration. 6. 5. 7. a rumbling so. like that of a train heard (by other observers) before the sh.

721. *Melverley*.—Rev. H. Holland-Howard. 3. 5.30. 5. 20 secs. 6. 5. 7. no.

722. *Monkhoppton*.—Anon.† (*Bridgnorth Journal*, Dec. 19). 3. 5.30. 5. ab. 10 secs. 6. < 4. 7. no.

723. *Much Wenlock*.—Rev. F. R. Ellis. 3. 5.35. 4. a. yes, 3 or 4 secs. b. 3 series of vibra, 12 secs. c. yes, 4 secs. e. mid. f. no. 5. 20 secs. 6. 6. 7. a heavy traction-engine passing.

724. *Neenton*.—Rev. J. C. Lyons. 3. ab. 5.35. 4. one series of vibra. e. beg. f. yes. 5. a few secs. 6. pr. 5.

725. *Newport*.—(*Shrewsbury Chronicle*, Dec. 18.) 3. ab. 5.30. 6. 5. 7. a heavy vehicle passing.

726. *Oakeley*.—Mr. J. Oakeley.* 3. 5.30. 4. one series. 5. 4 or 5 secs. 6. 5. 7. a strong wind; the so. acc. the sh.

727. *Oakly Park*.—Mr. T. Reason. 3. 5.30. 4. two series, a second or two bet. them, the second series much the stronger. 5. 5 or 6 secs. 6. pr. 6 or 7. 7. a brisk windy so. acc. the sh. b. p. 1 or 2 secs.

728. *Onibury*.—Mr. J. Woollam.* 3. 5.32. 4. one distinct sh., the motion wave-like. 5. ab. 40 secs. 6. 5. 7. a low rumbling like distant thunder. b. f. c. f. ab. 2 secs. e. f. imm. f. no.

729. *Oswestry*.—Anon.† (*Oswestry and Border Counties Advertiser*, Dec. 23). 3. ab. 5.30. 5. some secs. 7. a heavy train rumbling by.

730. Do.—Anon. (*Oswestry and Border Counties Advertiser*, Dec. 23). 3. ab. 5.25. 4. the motion like that of a boat. 6. < 4.

731. Do.—Mr. T. B. Stretton (*Liverpool Courier*, Dec. 19). 3. 5.35. 5. 15 to 20 secs. 6. the ceiling of one room cracked all over.

732. *Pant*.—Mr. T. Davies † (c. by Mr. C. S. Dennis). 3. ab. 5.28 or 5.29. 4. one series of vibra, continuous and grad. decreasing in int. 5. ab. 3 secs. 6. < 4.

733. *Peplow Mills*.—Mr. A. Barratt.* 3. 5.35. 4. a trembling sensation, and imm. a dull crashing so. as if some one struck the door twice and shook it for ab. 8 or 10 secs. 6. 5.

734. *Prees*.—(*Owesity and Border Counties Advertiser*, Dec. 23.) 3. ab. 5.30. 5. some secs. 6. pr. 5. 7. a rumbling so. p. the sh.

735. *Preesgrove*.—Mr. S. Barnfield* (c. by Mr. J. M. Clements). 3. 5.34.* 5. 3 secs. 6. < 4.

736. Do.—Miss Dutton (c. by Mr. J. M. Clements). 3. ab. 5.35. 4. a rocking motion of the bed. 6. 5.

737. *Priorslee*.—G. A. Greene.† 3. 5.30. 4. a rocking movement. f. yes. g. N. and S. 5. 25 to 30 secs. 6. 5. 7. so. heard by other observers.

738. *Pulverbach*.—Mr. R. de G. Benson (c. by Mr. E. S. Cobbold). 6. < 4. 7. a rush of wind in trees, or the upsetting of a load of stones.

739. *Quatford*.—Rev. T. Mayo.† 3. 5.31. 4. a continuous series of vibra. of uniform int. f. no. 5. ab. 6 secs. 6. 5. 7. a rumbling so. c. c. ab. d. no.

740. *Quatt*.—Mr. H. W. Smith.† 3. 5.30. 4. awakened by a noise like the violent knocking and shaking of doors.

741. *Ruyton-XI-Towns*.—(*Owesity and Border Counties Advertiser*, Dec. 23.) 3. ab. 5.30. 5. a few secs. 6. < 4.

742. *Shifnal*.—Rev. G. Lampard. 3. 5.0. 4. the motion like the swell of the sea, f. by a slight tremor. 5. ab. 8 or 12 secs. 6. 5. 7. a rushing whizzing so. like that of a sudden mighty wind.

743. Do.—Mr. G. Harris* (c. by Mr. J. Cox). 3. 5.34. 4. a. no. b. one series, ab. 5 secs. c. yes, ab. 6 secs. d. yes. e. mid. 6. 5. 7. distant thunder. b. p. 2 or 3 secs.

744. *Shrewsbury*.—Mr. F. R. Armytage† (c. by Mr. E. S. Cobbold). 3. 5.33. 4. the bed appeared to be rocked from N. to S. three times. 5. 3 secs. 6. 5. 7. a rumbling so. c. f.

745. Do.—Mr. T. P. Blunt† (c. by Mr. E. S. Cobbold). 3. 5.35. 4. four gentle and rather agreeable oscillations, like the motion of a boat at anchor. 5. 4 secs. 6. 5. 7. no, but other observers heard a so. like snow falling off the roof.

746. Do.—Mr. W. P. Hamilton.† 4. a rocking of the bed, wh. culminated in a violent sh. g. N. to S. 6. 5, an umbrella standing in the corner of a room was thrown down. 7. a loud rumbling acc. the sh.

747. Do.—Mr. Bryan Smith.* 3. 5.31. 5. 6 secs. 6. 4. 7. the so. resembled ten or twelve powerful men in the room above having a desperate struggle, with two distinct thuds as if some one had fallen on the floor, shaking the house to its foundation. b. c. c. c.

748. Do.—Anon.† (c. by Mr. J. M. Clements). 4. the bed trembled violently. 7. a rumbling so., like the water boiling over in the hot-water cistern, or a steam-roller passing.

749. Do.—Mr. W. L. Browne, jun. (*Shrewsbury Chronicle*, Dec. 18). 3. 5.35. 4. as if some one had hold of the foot of the bed and were shaking it, the movement culminating in the most pronounced vibr. g. W. to E. 5. ab. 5 secs. 6. 5. 7. a slight rumbling. b. p.

750. Do.—(*Owesity and Border Counties Advertiser*, Dec. 23.) 4. a waving motion from side to side, not unlike the rocking of a boat on a

moderate sea. 6. 5. 7. a low rumbling so. like distant thunder acc. the sh.

751. Do.—(*Birmingham Daily Gazette*, Dec. 18.) 3. 5.35. 4. two distinct sha., with an interval of a few secs. bet. them. 6. < 4.

752. *Smethcote*.—Mr. W. R. Blackett (c. by Mr. E. S. Cobbold). 3. 5.40. 5. $1\frac{1}{2}$ to 2 secs. 6. < 5. 7. a rumbling as of an approaching heavy dray heavily laden and driven rapidly; the so. decr. quickly after the sh. as though the dray had passed. b. p. c. f.

753. *Snailbeach*.—Anon. (*Onwestry and Border Counties Advertiser*, Dec. 23). 4. two sha., the second much the stronger and following the first imm. 7. the second sh. f. by a rumbling noise almost like distant thunder.

754. *Stanton Lacy*.—Rev. L. R. C. Bagot.† 3. 5.34. 4. one series. 6. 7. a heavy traction-engine passing.

755. *Stapleton*.—F. C. Pope. 6. < 4. 7. a rumbling, as of several waggons passing, heard for some secs.

756. *Stirchley*.—Rev. W. H. Painter (c. by Mr. E. S. Cobbold). 3. ab. 5.35. 4. a. yes. 6. 5. 7. a heavy vehicle passing. b. p.

757. *Stoke St. Milborough*.—Rev. J. Y. Smith.† 3. 5.30. 4. a. yes, 2 secs. b. 2 vibra., 1 sec. c. yes, 1 sec. d. yes. e. mid. 6. 5. 7. a roaring like that of a waterfall at a distance. d. yes. e. c. f. no.

758. *Stokesay*.—Rev. J. D. La Touche. 3. ab. 5.35. 4. three rather distinct sha. in immediate succession to each other, the middle one being the most severe. g. N. to S. 5. pr. $\frac{3}{4}$ min. 6. < 4. 7. the so. heard by other observers.

759. *Stow*.—Rev. J. J. Peglar.† 3. 5.30. 4. two series. 7. the second series f. by a loud rumbling noise as though several rats were running round the inside of the walls facing S. and E.

760. *Wellington*.—Mr. W. Bullock.† (c. by Mr. E. S. Cobbold). 3. 5.25. 7. a traction-engine passing. d. yes.

761. Do.—Mr. T. James.* 3. 5.36. 5. 2 secs. 6. 5. 7. no.

762. Do.—Anon. 3. 5.33. 5. ab. 10 secs. 6. 5. 7. the sh. p. by a loud buzzing roar like that of a severe colliery explosion.

763. Do.—Mr. G. Wilkinson.† (*Birmingham Daily Post*, Dec. 18). 4. two distinct sha., the first being shorter and more violent than the second. 6. 5. 7. a traction-engine passing.

764. Do.—(*Wellington Journal*, Dec. 19.) 4. bed swayed to and fro with pendulum-like regularity. 5. several secs. 6. 5.

765. *Wem*.—Hon. and Rev. G. H. F. Vane.† 3. 5.35. 4. a. yes, ab. 2 secs. b. 2 vibra. [series?] ab. 2 secs. each. c. no. e. mid. f. yes. 5. ab. 6 secs. 6. 5. 7. a traction-engine passing close by. b. p. ab. 2 secs. c. p. ab. 4 secs. e. p. ab. 4 secs. f. no.

766. Do.—Mr. T. Cumberland.† (c. by Mr. E. S. Cobbold). 3. ab. 5.35. 4. c. yes. 6. 5. 7. no.

767. *Westbury*.—Rev. F. Cooke.† 3. ab. 5.30. 4. one series, grad. increasing in int. e. end. f. yes. 5. ab. 10 secs. 6. 5. 7. so. heard. b. p. d. yes. e. p. a few secs.

768. *West Felton*.—Rev. H. Crane. 3. 5.30. 4. one continuous series of vibra. d. yes. e. mid. f. no. 5. pr. 20 or 30 secs. 6. 4. 7. a

dull heavy rumbling so, such as is produced by a heavily-laden waggon in a covered passage. b. pr. c. c. c. d. yes. e. c.

769. *Weston Rhynn*.—Mr. T. Jones * (c. by Mr. J. M. Clements). 3. ab. 5.40. 5. a few secs. 6. 5. 7. a violent gust of wind.

770. *Do*.—Miss S. Jones * (c. by Mr. J. M. Clements). 3. ab. 5.40. 6. pr. 5.

771. *Do*.—Miss A. M. Jones * (c. by Mr. J. M. Clements). 3. ab. 5.40. 5. ab. 15 to 20 secs. 7. a gale of wind, just before the vibr.

772. *Whitchurch*.—Rev. W. H. Egerton.† 4. only one sh. lasting a few secs. (but two shs. according to others, one imm. succeeding the other). f. yes (according to other observers). g. N. to S. 6. 5. 7. (according to others) a rumbling noise p. the sh.

773. *Whitton*.—Rev. P. Whiteford. 3. 5.35. 5. 3 or 4 secs. 6. < 5. 7. a rumbling so. during and after the sh.

774. *Woolstaston*.—(c. by Rev. E. D. Carr.) 3. 5.30. 5. some secs. 7. the sh. f. by a loud rumbling noise like a heavy waggon or threshing-machine passing.

775. *Worthen*.—Anon.† 5. ab. 20 secs. 6. 4.

776. *Wroxeter*.—Rev. R. Steavenson. 3. 5.40. 4. f. yes. 6. 5.

RADNORSHIRE

777. *Abbeycwmhir*.—Rev. E. H. Day.† 3. 5.35 A.M. 4. a continuous vibr., like that caused by a train passing through a tunnel under the house. 5. 3 or 4 secs.

778. *Boughrood*.—Mr. R. Parry * (c. by Mr. C. S. Dennis). 3. 5.32. 4. a. yes, ab. 2 or 3 secs. b. one, a sec. or two. 6. pr. 5. 7. a train passing within a mile or so.

779. *Boulthbrooke*.—E. Moberly. 3. 5.30. 6. < 5. 7. at first like a loud clap of thunder. b. p.

780. *Bryngwyn*.—Rev. J. Hughes.† 3. 5.35. 4. the bed shook and then rose and fell, ab. 5 secs., then it rocked from side to side for 10 or 12 secs. 5. ab. 15 secs. 6. < 5. 7. the so. at first like a cart passing along the road, then like distant thunder. b. f. c. f. 5 or 6 secs. d. yes.

781. *Chyrol*.—Mr. B. Palmer.* 3. 5.32. 4. only one sh. f. yes. 5. 1 or 2 secs. 6. < 5. 7. rumbling sos. as of an approaching vehicle, for ab. 3 secs., then the sh.

782. *Do*.—Rev. T. Macfarlane.† 3. bet. 5.30 and 5.40. 4. f. yes. 6. < 5. 7. so. heard.

783. *Disserth*.—Mrs. J. L. Herbert.* 3. 5.35. 4. a. yes, 11 secs. b. 6 vibra, 8 secs. c. yes, 11 secs. f. no. g. N.E. and S.W. 5. 30 secs. 6. < 5. 7. a deep rumbling so. something like thunder. b. p. 15 secs. c. f. 15 secs. d. yes. e. pr. c. f. no.

784. *Ednol*.—Mr. W. Jones. 3. 5.25. 4. one series. d. yes. f. yes. 5. ab. 3 secs. 6. 5. 7. snow slipping from the roof. b. p. c. p.

785. *Erwood*.—Mr. D. Williams (c. by Mr. C. S. Dennis). 3. 5.30.

4. d. yes. e. mid. 5. 2 or 3 secs. 6. pr. 5. 7. distant thunder, the so. p. the sh. ab. 2 secs.; the so. became grad. louder and then came the vibrs.

786. *Glasbury*.—Mr. A. Battiscombe. 3. 5.33. 4. a. yes. b. 3 to 5 secs. c. yes. d. yes. f. no. g. W. by N. to E. by S. 7. a heavy train advancing at great speed, it appeared to pass under the house, and then died away.

787. *Glascombe*.—Rev. T. Thomas.† 3. 5.32. 4. one series. c. no. 5. 2 or 3 secs. 6. < 4. 7. a waggon passing. b. p.

788. *Guern-i-Arghwydd*.—(c. by Mr. J. Campbell) 3. 5.45. 4. two distinct shs., each lasting 2 or 3 secs., the second more severe. 6. pr. 7. 7. the wind howling or the rush of a large quantity of water; the so. heard bet. the two parts of the sh.

789. *Knighton*.—Mr. A. W. Brightmore.† 3. 5.34. 4. g. S.W. to N.E. 5. ab. $\frac{3}{4}$ min. 6. < 5. 7. escaping steam.

790. Do.—(*Hereford Times*, Dec. 26.) 3. ab. 5.35. 5. 20 to 30 secs. 6. < 5.

791. *Llanbadarn-fawr*.—Rev. A. Jordan.† 3. ab. 5.35. 5. ab. 30 secs. 6. 6. 7. as if the kitchen boiler had burst.

792. *Llanbadarn Fynydd*.—Rev. W. Thomas. 3. ab. 5.30. 5. 4 or 5 secs. 6. 5. 7. no, but others heard a so. like thunder.

793. *Llanbister*.—(c. by Rev. W. Fulford.) 3. 5.35. 6. 7. 7. no.

794. *Llandrindod Wells*.—Rev. W. Bowen-Davies.† 3. 5.34. 4. a slight vibratory motion for a few secs., then a vert. mot. as if the bed were raised many inches. 6. 6. 7. a train passing. b. p. d. no.

795. Do.—Mr. J. M. Evans.† 3. 5.33. 4. two series. 6. < 4.

796. *Llanellwedd*.—Rev. G. B. Sharpe. 3. 5.0. 5. very short. 6. < 5. 7. carts on the road.

797. *Llanfihangel Rhyd Ithon*.—B. Griffiths.* 3. ab. 5.30. 6. pr. 7. 7. a strong wind.

798. *Llanstephan*.—Rev. D. Morgan.* 3. 5.35. 5. ab. 10 secs. 6. < 4. 7. a strong gust of wind travelling from S.E. to N.W.

799. *Maesollech Castle*.—Mr. A. Grimble.* 3. ab. 5.30. 4. the bed shook violently 30 or 40 times. 6. < 5. 7. a crash app. on the roof overhead, as if 40 or 50 men had each flung down a sack of coals at the same moment.

800. *Newbridge-on-Wye*.—Mr. W. Jones * (c. by Mr. C. S. Dennis). 3. 5.33.* 4. the house rocked 3 times from W. to E. (the house and station are built N. and S.). 5. ab. 6 secs. 6. 5. 7. a rumbling so. wh. ended 2 or 3 secs. before the rocking began.

801. *New Radnor*.—Rev. A. Garnons-Williams.† 3. 5.35. 5. 5 to 10 secs. 6. 7. 7. a traction-engine passing; the so. c. with the sh.

802. Do.—Mr. H. Summers.† 3. ab. 5.32. 4. a trem. mot. f. by a rocking of the bed. 5. ab. 6 secs. 6. < 5. 7. a rumbling noise of ab. 3 secs. duration, and then the trem. mot.

803. *Old Radnor*.—Rev. A. B. Dickinson.* 3. 5.35. 4. 6 or 7 regular vibrs. f. there seemed to be an upheaval, but no subsidence was afterwards felt. g. E. and W. 5. 5 or 6 secs. 6. 7. 7. as if a chimney were suddenly set on fire. b. p. ab. 3 secs. d. no.

804. *Pantydwr*.—Mr. E. Davies (c. by Mr. C. S. Dennis). 3. ab. 5.35. 4. d. yes. e. mid. f. no. 5. ab. 8 secs. 6. 4. 7. no.

805. *Presteign*.—Mr. F. Bromley.† 3. 5.36. 4. a. slight. b. one series, 15 secs. c. slight. d. rapidly incr. in int. and rapidly passed away. e. mid. and end. f. yes. g. pr. N.W. and S.E. 5. < 20 secs. 6. < 7. 7. as of rending rocks below the house. b. p. c. f. e. c. The sound seemed to travel from N.W. to S.E.

806. Do.—Mr. H. Jenkins. 3. ab. 5.35. 4. b. two, for 3 or 4 secs. c. yes, a few secs. d. yes. e. beg. f. yes. 6. 7. a traction-engine going down the street; the so. had ceased before the vibra. began.

807. Do.—(*Daily Chronicle*, Dec. 18.) 3. 5.30. 6. < 5. 7. a discharge from a large piece of ordnance, f. by a rumbling like the rolling after a loud clap of thunder.

808. Do.—(*Leominster News*, Dec. 18.) 3. 5.30. 6. pr. 7.

809. Do.—(*Hereford Journal*, Dec. 19.) 3. ab. 5.33. 6. pr. 7; app. no damage to buildings.

810. *Whitton*.—Rev. H. B. C. Davies. 3. 5.35. 6. 7. 7. thunder and wind.

BRECONSHIRE

811. *Aberclydach*.—Dr. J. J. Williams, J.P. 3. ab. 5.30 A.M. 4. two series, ab. 1 sec. each, interval ab. 1 sec. g. the room swayed from N. to S. 6. 5. 7. a heavy goods-train going by the windows. b. p. c. f. d. yes. f. no.

812. *Abergwesyn*.—Rev. J. Jones.* 3. 5.26. 4. a. yes, 3 secs. b. one series, 4 secs. c. no. e. beg. 5. 7 secs. 6. 5. 7. heavy snow falling from the roof; the so. c. with the sh.

813. *Brecon*.—Mr. T. Butcher.† 3. 5.37. 4. the sh. consisted of two parts, the first grad. decr. in int. and was f. after a scarcely perceptible interval by a much more powerful sh. 6. 5. 7. no.

814. Do.—Mr. E. Jones † (c. by Mr. J. Gall). 3. ab. 5.25. 4. felt as if in a sieve and being shaken. 5. ab. 7 secs. 6. 5. 7. thunder.

815. Do.—Mrs. R. Powell.* 3. ab. 5.37. 4. only one sh., at the beg. as if a heavy-footed person were walking about the room. f. yes. 5. 25 to 30 secs. 6. pr. 5.

816. *Builth*.—Mr. A. G. Vaughan † (c. by Mr. W. W. B. Fry). 4. a vert. mot. as if the bed were sinking, then a swaying from E. to W. 6. 5. 7. a heavily-laden goods-train passing close to the house; the end of the so. c. with the beg. of the sh.

817. Do.—Mr. E. Davies* (c. by Mr. W. W. B. Fry). 3. 5.32. 4. a steady trem. or swaying mot. 5. 15 secs. 6. < 4. 7. no.

818. *Crickhowell*.—Mr. P. E. Hill. 3. 5.30. 4. a. yes, 10 secs. b. one series, 30 or 40 secs. c. no. d. yes. e. end. f. no. 6. 5. 7. a person walking heavily over the room.

819. *Devynnock*.—Anon.* (c. by Rev. R. Evans). 3. 5.30. 5. 4 or 6 secs. 6. 5. 7. an unusual rumbling. b. p.

820. *Gwenddwr*.—Rev. W. G. Williams. 3. 5.30. 4. a. trem. mot.

from W., 3 secs. b. one, 2 secs. c. no. d. only one max. f. yes, app. ab. 8 ins. 5. 5 secs. 6. < 5. 7. a train or heavy waggon passing; the so. entirely p. the sh.

821. *Gwernyfed Park*.—Hon. Mrs. T. Wood.† 3. ab. 5.33. 4. 7. a rumbling noise (like a train passing underground), ab. 4 secs., f. by a slight trembling for ab. 5 secs.; this was f. imm. by a sudden shock or concussion, 2 or 3 secs., attended by a very loud noise like a cannon-shot; and then a rather severe shaking for ab. 6 or 8 secs. The loud noise wh. attended the "concussion" does not seem to have been heard in some of the houses about here. 6. 7?

822. *Hay*.—Mr. R. J. Sheperd.† 3. 5.30. 4. b. only one series, ab. 5 or 6 secs. c. yes, ab. 5 secs. d. yes. e. mid. 6. < 7; a chimney fell in the town. 7. a train passing over a bridge when the obs. is underneath. b. p. 2 or 3 secs. c. c. d. yes. f. yes.

823. *Llandilo'r Fan*.—(c. by Rev. P. Morgan.) Sh. felt.

824. *Llangammarch Wells*.—Mrs. D. E. Williams.† 4. the bed seemed to be raised up and then moved northward. 6. 5. 7. like some one walking across the room, and a hissing so.

825. *Llangattock*.—Rev. T. J. Bowen.† 3. ab. 5.30. 7. the so. heard after the shaking had ceased.

826. *Llangorse*.—(c. by Rev. W. Bowen.) 3. 5.30. 4. a rocking movement. f. yes. 5. 4 secs. 6. 5. 7. no.

827. *Llanigon*.—Rev. W. E. T. Morgan.† 3. 5.33. 4. rapid regular vibra. of ab. equal int. throughout. 5. ab. 20 secs. 6. < 5. 7. a goods-train passing over a bridge. b. pr. p.

828. *Llanymia*.—(c. by Rev. W. Williams.) 4. sh. distinctly felt. 7. a heavy railway train.

829. *Maesmynis*.—Rev. W. Williams.† 6. < 4. 7. a heavy railway train.

830. *Talgarth*.—Rev. J. Bowen.* 3. 5.37. 4. a. yes, ab. 3 to 5 secs. b. one or possibly two prin. vibra., ab. 3 to 5 secs. c. yes, ab. 6 secs. d. yes. f. yes. 5. ab. 14 secs. 6. < 5. 7. a train going by under the house. b. p. ab. 3 secs. c. f. several secs. d. yes. e. pr. c. f. no.

831. *Do*.—Anon. (c. by Mr. C. S. Dennis). 3. ab. 5.35. 4. one series. d. yes. e. end. f. yes. 6. 5. 7. a rumbling so. b. p. c. f. d. yes. e. c.

832. *Talybont*.—Mr. J. Prosser* (c. by Mr. J. Gall). 3. 5.25. 4. one series. 5. 3 secs. 6. 5. 7. distant thunder. b. c. c. f. 2 secs. e. c.

833. *Talylllyn*.—Mr. E. Richards* (c. by Mr. J. Gall). 3. 5.33.* 5. 2 or 3 secs. 6. pr. 4. 7. the sh. p. by a dull rumbling so. like the approach of a heavy train running on snow, lasting ab. 3 or 4 secs.; it was f. by a somewhat similar so. wh. seemed to die away like distant thunder, ab. 3 or 4 secs.

834. *Three Cocks Station*.—Mr. Morris* (c. by Mr. C. S. Dennis). 3. 5.35. 4. a. yes, ab. 2 secs. b. 3 vibra. of ab. equal int. in quick succession, 3 secs. 5. ab. 5 secs. 6. 5. 7. a rumbling so. very like an approaching train, loudest at the beg. of the sh. and ab. a sec. before it.

835. *Torpanton*.—Mr. C. Mallet* (c. by Mr. J. Gall). 3. 5.30. 4. one sh. 5. ab. 4 secs. 6. 5.

836. *Tretower*.—Rev. J. O. Evans† 3. ab. 5.30. 4. d. yes. 5. ab. 15 to 20 secs. 6. 7? 7. a large number of hard balls rolled over boards b. f.

837. *Vaynor*.—Rev. J. E. Jenkins 3. 5.27. 4. two shs., ab. 2 secs bet. them. 6. books were disarranged. 7. a wheelbarrow rolling on the path underneath the window. b. p.

838. *Velyn newydd*.—Mr. J. W. Vaughan* 3. 5.35. 4. one sh. f. no. 5. 10 to 15 secs. 6. 5. 7. a cartload of stones being tipped, it grad. incr. in int. until the bed was sharply shaken, and then it seemed to die away slowly in the distance. b. p. ab. 20 secs. c. f. ab. 10 secs. e. c. f. no.

MONMOUTHSHIRE

839. *Abercarn*.—Mr. W. E. James 3. bet. 5.30 and 5.45 A.M. 5. ab. 20 to 30 secs. 6. < 5. 7. no.

840. *Abergavenny*.—Mr. N. F. Davey* 3. ab. 5.30 or 5.31. 4. a. yes, ab. 2 secs. b. 10 or 12 prin vibra., ab. 6 secs. c. yes, ab. 2 secs. e. end, ab. 7th or 8th sec. f. no. g. N.N.W and S.S.E. 5. 9 secs. 6. < 5. 7. the moving of furniture. b. p. ab. 1 sec. c. f. ab. 1 sec. d. yes.

841. Do.—Anon.* (c. by Mr. L. D. Gamble). 3. 5.35. 4. a. no. b. two series, the first ab. 15 secs., the second ab. 5 secs., interval 2 or 3 secs., the first stronger. c. yes, 2 or 3 secs. e. mid. f. yes. 6. 5. 7. a heavy thud as of a quantity of snow falling from the roof, and then a rumbling noise. b. c. c. c. d. yes. e. c. f. no.

842. Do.—Dr. J. Glendinning. 3. 5.30. 4. two distinct sways. f. yes. 5. ab. 10 secs. 6. 5. 7. no.

843. Do.—(c. by Dr. J. Glendinning.) 6. 7.

844. Do.—(c. by Mrs. B. St. J. Attwood-Mathews.) 6. 7.

845. Do.—(*The Times*, Dec. 18.) 6. 7; no serious damage reported. 7. the so. variously described: an approaching traction-engine, wind rushing through trees, and the flowing of the sea on a pebbly shore.

846. Do.—(*Abergavenny Chronicle*, Dec. 18.) 3. ab. 5.30. 6. 7. 7. a heavy goods-train passing.

847. *Abersychan*.—Mr. E. Cooke† 3. 5.28. 4. one series. 5. 2 secs. 6. 5? 7. a so. as of snow rushing from the roof and falling on the ground, and almost simultaneously, certainly not more than a sec. later, the vibr. commenced.

848. Do.—Dr. J. W. Mulligan† 3. pr. 5.29. 6. 5.

849. *Bedwas*.—Rev. G. Thomas† 3. 5.30. 4. one series. d. yes. e. mid. f. yes. 5. 6 or 7 secs. 6. 5. 7. a rumbling so. heard (by another obs.) like that of an explosion underground. b. p. c. f.

850. Do.—Mr. C. Styles* (c. by Mr. J. Gall). 3. ab. 5.40. 4. trem. mot.: a few secs. quietness; a sh.; slight pause; a greater sh.; slight pause; the greatest sh., then a trem. mot. wh. grad. died away. 6. 6. 7. a rumbling so. b. p. c. p.

851. *Bishton*.—(c. by Rev. J. Hooper.) 3. ab. 5.30. 6. 5.

852. *Blackwood*.—Mr. J. D. James* 3. ab. 5.40. 4. the vibra. of the same int. throughout. 5. 15 to 20 secs. 6. pr. 5. 7. no.

853. Do.—Mr. H. T. Evans.† 3. 5.25. 4. a continued tremor with lateral vibra., one series only. d. yes. e. mid. f. yes. 6. < 5. 7. a colliery explosion.

854. Do.—(*South Wales Daily News*, Cardiff, Dec. 18.) 6. 8? a signal-box on the Monmouthshire section of the Great Western Railway was damaged; the brickwork cracking and parting for some distance.

855. *Blaenavon*.—E. Freeman.† 3. 5.30. 4. d. yes. e. mid. 6. 5. 7. an explosion.

856. *Bryn Hedydd*.—Mr. T. Rees.* 3. 5.32. 4. 3 distinct vert. shs. 5. ab. 3 secs. 6. pr. 5. 7. a violent gale of wind approaching with a roar from the N.E., and just as it seemed about to strike the house the shs. were felt; the roar then passed away to the S.W.; it lasted ab. 15 secs. b. p. c. f. e. c.

857. *Caerleon*.—(*South Wales Times*, Newport, Dec. 18.) 3. ab. 5.30. 5. ab. 30 secs.

858. *Caldicot*.—Mr. R. Hosken* (c. by Mr. T. D. Roberts). 6. < 5.

859. *Cefn Parc*.—Dr. A. Davies.† 3. 5.32 to 5.33. 5. > 2 or 3 secs. 6. < 4. 7. a rumbling noise before the sh. heard by another obs.

860. *Chepstow*.—Mr. E. P. King.† 3. 5.30. 4. two distinct shs. (according to another obs. who was awake). 6. pr. 5. 7. a heavy waggon going down the street.

861. Do.—(c. by Mr. C. E. Rake.) 6. in one house a picture was thrown down from the wall.

862. Do.—(*Chepstow Weekly Advertiser*, Dec. 19.) 3. 5.35. 6. pr. 7.

863. *Clytha Park*.—Mr. J. H. Canning.† 3. bet. 5.30 and 5.35. 4. f. yes. 5. ab. 15 secs. 6. 6; pictures on a wall lying E.S.E. and W.N.W. were tilted up, in some cases at least half an inch at the N. end.

864. *Cwmcarvan Court*.—Mr. R. H. Oakley† (c. by Rev. H. T. M. Bickwell). 3. ab. 5.40. 4. one series of violent vibra. f. yes. 5. 4 or 5 secs. 6. < 5. 7. as though a heavy waggon were rattling through the house.

865. *Dingestow Court*.—Mr. S. C. Bosanquet.† 3. 5.34 or 5.35. 4. two series, separated by an interval of ab. 1 sec. [the first pr. stronger]. 5. > 10 secs. 6. < 5. 7. a rumbling so. acc. the sh. Those who were awake heard a crash as if a heavy body had fallen.

866. *Ebbw Vale*.—Mr. J. W. Davies.† 3. 5.40. 4. two [series of] prin. vibra., 6 secs. c. yes, 2 secs. e. beg. 5. 8 secs. 6. 5. 7. a loud report heard during the prin. vibra., and a whizzing so. during the trem. mot.

867. *Garndiffaith*.—Dr. W. Wilson.† 3. ab. 5.30. 6. pr. 5. 7. no, but several persons heard a rumbling before the vibra.

868. *Gilwern*.—Mr. T. D. Peirce. 3. ab. 5.30. 4. two [series of] severe vibra. 5. ab. 30 secs. 6. < 4. 7. a dull rumbling so. (as of a passing conveyance) succeeded the first sh.

869. *Goytra*.—Rev. D. T. Davies.† 4. two series. 7. a very loud rumbling noise imm. p. the second series.

870. *Grosmont*.—Mr. G. R. Leighton.† 3. ab. 5.27. 4. vibr., sh., vibr. 5. ab. 5 secs. 6. 7? 7. an underground train passing: the so. p. the strongest part of the sh. ab. 1 or 2 secs. c. f. 2 or 3 secs.

871. *Guernsey*.—Rev. J. Blower. 3. 5.30. 4. a. yes, ab. 4 secs. b.

5 secs. c. yes, 2 secs. e. mid. f. yes. 6. 6 or 7. 7. a heavy dray or traction-engine. b. p. 2 secs. c. c. e. c. f. no.

872. *Hendre, The*.—(c. by Rev. J. T. Harding.) 6, 7.

873. *Henllys*.—Mr. G. Williams* (c. by Rev. R. Jones). 3. 5.26. 4. a. yes. b. one series. 7. a muffled train running over a bridge. b. p.

874. *Itton Court*.—Mr. E. Curra. 3. 5.32. 4. one series. 5. 3 or 4 secs. 6. < 4. 7. a great rushing wind from N. to S., f. without a break by a so. like a train passing under the house, and this, again without a break, by the sh.

875. *Lantarnam*.—Anon* (c. by Mr. F. J. Mitchell). 4. the obs. saw the ceiling waving. 7. a heavy rumble like a traction-engine crossing a bridge.

876. *Llanellen*.—Rev. W. D. Jones† 3. ab. 5.40. 4. a. yes, ab. 7 secs. b. prin. vibra. for ab. 5 secs. f. by two vertical motions. c. yes, ab. 5 secs. d. yes. 6. < 5.

877. *Llanfrefcha*.—Mr. F. J. Mitchell. 3. 5.30. 6. 4. 7. according to one obs. like the blow of a wave on the sea-shore, according to another like a traction-engine going over a bridge.

878. *Llangattock Lingoed*.—Rev. G. B. Jones† 3. 5.30. 4. a. yes. ab. 2 secs. f. yes. 6. < 5. 7. b. p. 1 or 2 secs.

879. *Llangattock vibon avel*.—Miss M. J. E. Maclaverty.† 3. bet. 5.30 and 5.35. 4. d. yes. e. mid. 5. ab. 20 secs. 6. 7. 7. a loud rumbling so. like stones rattling down on the roof; the so. seemed to die away as the sh. began.

880. *Llangibby*.—(c. by Rev. H. A. Williams.) 4. f. yes. 6. 5. 7. a rumbling so. b. p.

881. *Llanhilleth*.—Mr. T. J. Frost† 3. 5.28. 4. b. ab. 6 secs. c. yes, ab. 2 secs. e. mid. and end. f. no. 5. ab. 8 secs. 7. a very heavy cart passing the house.

882. *Llanllowell*.—Rev. G. M. Williams. 3. 5.32. 4. a. yes. c. yes. d. yes, one series. e. end. 6. 5. 7. a peculiar rumble. b. p.

883. *Llanthewy*.—Rev. W. A. Evans† 3. 5.35. 4. b. one, 1 sec. c. yes, 2 secs. f. no. 6. 5? 7. an empty goods-train passing over an iron viaduct; the end of the so. c. with the beg. of the vibra.

884. *Llanthony Abbey*.—Rev. Father Ignatius, O.S.B.* 3. ab. 5.35. 4. two strong sha. 5. ab. 3 or 4 secs. 6. < 5. 7. a sudden and violent rush of wind, equally loud throughout; this so. was in the air, no so. of any kind underground. b. p. c. f. 1 or 2 secs.

885. *Llantilio Court*.—(c. by Sir H. M. Jackson, Bart.) 3. 5.35. 4. the post of the bed lifted 4 or 5 times. 6. < 5. 7. a rushing mighty wind.

886. *Llantrissant*.—Rev. W. Watkins Jones† 3. ab. 5.32. 4. c. yes, some secs. 6. 5. 7. a threshing-machine. b. c.

887. *Llanvair Kilgeddin*.—Rev. W. J. C. Lindsay.† 3. 5.30. 4. the bed distinctly oscillated N. and S. 6. 5. 7. a traction-engine (according to another obs.).

888. *Llanvapley*.—Anon.† (c. by Mrs. Lloyd). 3. ab. 5.40. 6. < 5. 7. a rumbling so.

889. *Llanvetherine*.—Miss M. Fisher. 3. 5.40. 6. < 4. 7. a train passing.

890. *Llanvihangel Crucorney*.—Mr. J. Wingfield.† 3. 5.30 or 5.33. 4. e. end. f. yes. 5. 25 to 30 secs. 6. 5. 7. a rumbling noise like thunder, then the sh.

891. *Llwynarthan*.—Mr. F. G. Evans, F.R.A.S.† 3. 5.33. 4. a violent oscillation, only one series. f. no. 5. ab. 10 secs. 6. pr. 5. 7. a rushing so. p. the sh. for 5 secs., but there was no interval bet. them.

892. *Maindee*.—Rev. W. M. Willett.† 3. 5.32. 4. the bed lifted 4 or 5 times. 5. ab. 5 secs. 6. 5.

893. Do.—Mr. J. T. Southall (c. by Mr. G. J. Symons, F.R.S.). 4. a transverse shaking of the ground, f. by a severe sh. or thump, wh. seemed to throw the bed upwards. 6. 5. 7. a heavy traction-engine passing rapidly.

894. Do.—Anon.* (*South Wales Times*, Newport, Dec. 18). 3. ab. 5.35. 5. some secs. 6. slight cracks appeared in several ceilings. 7. a loud rumbling very like that made by a steam-roller passing along a road; this ceased and then came a violent shaking of the ground; when the sh. ended there was a dull heavy thud like the noise made by a heavy body on striking the earth.

895. *Mathern*.—Mr. J. W. Stanton. 3. 5.30. 4. a. yes. b. 2 vibra. 5. ab. 4 or 5 secs. 6. 6. 7. a train in a tunnel. b. p. c. c.

896. *Monmouth*.—Mr. E. H. Culley.† 3. 5.33. 4. the bed oscillated laterally, app. from the N. b. ab. 8 or 10 secs. 6. 6.

897. Do.—Mr. Smith* (c. by Mr. E. H. Culley). 4. a heavy concussion, as if a heavy weight had been let fall in the room above, f. by oscillations. 7. a moaning or roaring wind, or the whizzing of an immense flight of birds.

898. Do.—Mr. A. W. Wiseman* (c. by Mr. E. H. Culley). 7. like wind in the elm-trees wh. surround the obs.'s house, f. by oscillations.

899. Do.—Anon.* (c. by Mr. E. H. Culley). 4, 7. a rumble coming from the N., as if some heavy vehicle were passing, the noise seeming to terminate with a louder clap, and it passed away to the S. The obs. went to the window wh. faces S.E., and was then pitched forward and backward two or three times.

900. Do.—Mr. H. W. Reynolds.† 3. 5.40. 4. b. 3 or 4 vibra. c. no. f. yes. 5. 4 secs. 6. 5. 7. a heavy waggon driven at a furious rate over stones; the so. acc. the sh.

901. Do.—(*Monmouthshire Beacon*, Monmouth, Dec. 18.) 3. bet. 5.35 and 5.40. 5. 5 to 10 secs. 6. pr. 4 6. 7. the sh. acc. by a rumbling noise.

902. *Newport*.—(c. by Mr. G. H. Jack, F.G.S.) 3. 5.32. 4. f. yes, an upward motion only. 5. 1 to 2 secs. 6. 5. 7. a rumbling so. like heavy traffic. b. p. 3 or 4 secs. d. yes.

903. Do.—Mr. G. W. White.* 3. 5.30. 4. a. yes, ab. 2 secs. b. ab. 5 or 6 jerks for ab. 3 secs. c. slightly. d. yes. e. mid. 6. 4 5. 7. a steam-roller passing at a distance of 2 or 3 yards.

904. Do.—(*South Wales Times*, Newport, Dec. 18.) 3. ab. 5.30. 6. In one house, the blinds had been hung up loosely for the night and fell down; in others, a tall glass ornament was knocked over and broken, a set of toilet-ware in a bedroom was broken to pieces, and a gas-burner was jerked so that the light went out.

905. *Pandy*.—Mr. S. Spencer.* 3. 5.33. 4. a. yes, 3 to 4 secs. b. one [series], 3 to 4 secs. c. no. d. yes. e. mid. f. yes. 6. 7. 7. no.

906. *Penhow*.—Mrs. J. Ward.* 3. 5.30. 6. 5. 7. thunder (according to another observer).

907. *Penybidull*.—(c. by Rev. G. V. Collison.) 6. 6.

908. *Pontnewydd*.—Mr. T. Taylor.† 3. ab. 5.32. 5. ab. 3 secs. 6. pr. 4. 7. a rumbling so., as if a heavy dray were passing, ab. 2 secs, grad. dying away; then a so. as of rushing wind, 1 to 2 secs.; the beg. of the so. f. instantly on the dying away of the tremor.

909. *Pontypool*.—Mr. H. B. Robinson.* 3. ab. 5.35. 5. ab. 15 or 20 secs. 6. < 4. 7. the passing of a heavy goods or mineral train; after the tremor ceased the so. was somewhat different, like the movement of a heavy box or piece of furniture in the next house. b. p. slightly. c. f.

910. *Portskewett*.—Rev. W. H. Williams.* 3. 5.32. 4. one continuous series of vibrs., app. horizontal. g. S.E. to N.W. 5. bet. 5 and 10 secs. 6. 5. 7. a dog scratching himself under the bed. b. c. c. pr. c.

911. *Do*.—Mr. F. Dixon (c. by Mr. J. Gall). 3. 5.30. 4. as of being rocked backwards and forwards. 5. ab. 2 secs. 6. 5. 7. distant thunder; this f. the first [sic] sh. lasting ab. 2 secs.

912. *Do*.—Anon.* (c. by Mr. R. Hosken). 3. 5.32.

913. *Raglan*.—Rev. C. M. Perkins.* 3. ab. 5.36. 4. the motion like that of a ship at sea. 5. ab. 2 or 3 secs. 6. < 5. 7. a rumbling, as if a traction-engine were approaching, before the vibr., lasting ab. 2 or 3 secs.

914. *Do*.—Mr. A. Lewis.* 3. ab. 5.30. 5. ab. 3 secs. 6. 5. 7. a so., something like thunder, ab. 2 mins. [sic] before sh.

915. *Rhivoderin*.—Mr. J. Rothcas † (c. by Mr. J. Gall). 3. 5.30. 5. ab. 4 secs. 6. < 4. 7. a rumbling so., like a distant explosion and lasting ab. 5 or 6 secs., f. the sh.

916. *Risca*.—Mr. G. B. Robathan.† 3. 5.30. 4. the bed app. lifted from the S., then it quivered and fell back in position. 5. perhaps $\frac{1}{2}$ min. 6. 5. 7. no.

917. *Do*.—Mr. G. B. Williams.* 3. 5.30. 4. one sudden sh. f. no. 5. ab. 5 secs. 6. < 5. 7. no.

918. *Rockfield*.—Rev. J. T. Harding. 3. 5.37. 4. trem. mot. increasing in int. and ending suddenly with a heavy thud as of a great weight falling in the room above. f. no. 5. > 3 secs. 6. < 4. 7. the approach of a railway train grad. increasing in int.; the so. c. with the vibr. and was much the loudest at the final sudden thud.

919. *Rogerstone*.—Mr. J. Williams (c. by Mr. R. Hudson). 3. 5.32. 4. shaken 3 or 4 times from side to side, only one sh. 5. ab. 5 to 8 secs. 6. 5.

920. *Rumney*.—Miss N. Tucker* (c. by Rev. M. Morgan). 3. 5.30. 4. an unusual rumble; some 6 or 7 secs. later a second sh. wh. made the house rock. f. yes. 6. 5. 7. a heavy express train passing near.

921. *St. Arvans*.—Mr. C. E. Rake.* 3. 5.34. 4. a. yes, ab. 4 secs. b. two series, ab. 10 secs. each, interval bet. them ab. 5 secs. c. yes, ab. 5 secs. e. mid. f. yes. 5. ab. 35 secs. 6. 6. 7. a heavy waggon going down the road. b. p. ab. 3 secs. c. p. ab. 3 secs. d. yes. e. p. ab. 2 secs.

922. *St. Mellons*.—Mr. J. Allen † (*Western Mail*, Cardiff, Dec. 18). 3. 5.33. 6. 5.

923. *Shirenewton*.—Mr. E. J. Lowe, F.R.S. 3. 5.32.* 4. (according to another obs.) three wave-like movements, S. to N. 7. a roll of distant thunder.—“My books on book-shelf on west wall were all moved upwards 1 to 2 ins. and so were a number of cigar and other boxes standing on each other. Books on shelves on N. and E. walls were not moved. At the end of my bookcase on the W. wall I had a row of books piled on each other, i.e. books of different sizes, and they were pushed close to the wall to keep them from falling. The earthquake moved these books in a singular way.

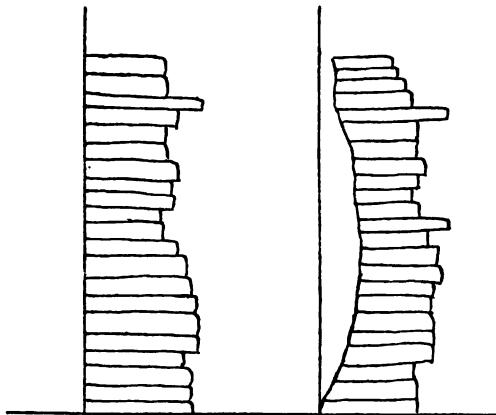


FIG. 2.

They were not moved at the base, but *most* moved in the middle (their height was 4 feet). A few slates on the roofs of some of my cottages were moved, and a chimney-pot dropped sideways on the chimney. No clocks stopped in this house, and on the cap of the mercurial pendulum of my astronomical clock I had some small weights from $\frac{1}{2}$ grain to 4 grains, none of these moved.”

924. *Sirhowy*.—Mr. P. Smith. 3. 5.50. 4. a. no. b. one series. c. no. d. of the same int. throughout. g. N. and S. 5. 4 or 5 secs. 6. 5. 7. no.

925. *Tintern*.—Mr. W. J. Saunders † (*Western Mail*, Cardiff, Dec. 18). 3. ab. 5.30. 5. ab. 10 secs. 6. < 5. 7. a rumbling noise.

926. *Tredegar*.—Mr. W. H. Routledge, J.P.* 3. 5.31. 4. 3 or 4 distinct vibra. in ab. as many secs. or rather less, a rocking motion; after 1 or 2 secs. a heavy trem. mot. for 1 or 2 secs., wh. appeared to heave up from E. to W. and then subside suddenly. 5. ab. 6 or 7 secs. 6. 5. 7. a so. like a rushing wind, then the first series of vibra., after wh. there was no so.

927. *Tredunnoch*.—Anon.† (c. by Rev. C. T. Salusbury). 3. ab. 5.30. 4. f. yes, slightly. 6. 5.

928. *Trelleck*.—Rev. T. Davies.† 3. 5.30. 4. the bed heaved up and down, and also moved from side to side. 5. > 10 secs. 6. 5 or 6. 7. a traction-engine passing.

929. *Tycoch*.—B. Meese.* 3. 5.40. 4. the house swayed like a small boat on an angry sea. 6. < 5. 7. a distant noise, as of thunder, seemed to be coming gradually nearer for ab. 5 secs., and then the house shook; this shaking was acc. the whole time by a tremendous roar, like that of an oil-factory on fire; the roar then died away in the distance with the same kind of noise as at first.

930. *Usk*.—Mr. J. Ault.† 3. 5.28. 5. 10 to 12 secs. 6. < 4. 7. e. c.; the vibra. and so. died away together.
931. Do.—(*County Observer*, Usk, Dec. 19.) 3. ab. 5.30. 4. three distinct sha. 6. < 5. 7. the sha. acc. by a peculiar rumbling noise.
932. *Woodland Park*.—Mr. E. G. Clarke. 3. 5.33. 4. the bed shaken as if by a very heavy man walking across the room; ab. 2 or 3 secs. after, a noise like a heavy person getting out of bed with a thump, at the same time it seemed as if a heavy person were crossing the room. 6. 5.

SOMERSETSHIRE

933. *Abbots Leigh*.—Mr. R. Phillips† (*Bristol Observer*, Dec. 19). 5. 5 to 6 secs. 6. pr. 5. 7. a rumbling noise.
934. *Alcombe*.—Miss E. Cooke. 3. 5.35 A.M. 4. d. yes. 5. ab. 5 or 6 secs. 6. 5?
935. *Ashton Court*.—Mr. A. Way.† 3. 5.35. 4. one distinct sh. f. yes. 6. 5. 7. a rumbling noise, coinciding with the sh.
936. *Barrow Gurney*.—Mr. F. Were.† 4. g. W. to E. 6. 5. 7. a blast of wind and a big weight dropped down on the floor above; the so. acc. and f. the sh., the so. being loudest after the oscillations were ended.
937. *Bath*.—E. M. Hare.* 3. 5.37. 4. a swaying of the room. g. S.W. to N.E. 5. > 30 secs. 6. 5. 7. a rumbling so. at the beg. of the sh., like a traction-engine passing.
938. Do.—Rev. H. H. Winwood, F.G.S.† 3. 5.32. 4. the vibra. incr. in int. e. end. f. no. g. pr. E. and W. 5. ab. 4 to 5 secs. 6. 5. 7. a roaring like wind down a long chimney. c. c. f. no.
939. Do.—Miss M. L. Jacques.† 3. bet. 5.30 and 5.40. 4. 3 vibra. of an undulating nature. 6. 5. 7. a very heavy goods-train or traction-engine.
940. Do.—Miss A. M. E. Maitland.† 3. ab. 5.30. 4. the vibra. extremely rapid and continuous. g. S. to N. 5. ab. 20 secs. 6. 5. 7. no.
941. Do.—Anon.† 3. 5.35. 4. the whole house seemed to tremble violently. 6. < 4. 7. the sh. acc. by a noise as of a strong wind blowing.
942. Do.—Miss E. Goodwin.† 3. 5.33. 7. shortly after the vibr. ceased, a so. like distant thunder, lasting only 1 or 2 secs.
943. Do.—Miss C. F. Murray.† 3. ab. 5.30. 4. g. W. to E. 6. pr. 6. 7. no.
944. Do.—Mrs. Spachman.* 3. 5.32. 5. quite 30 secs. 6. several small ornaments in the drawing-room were thrown down. 7. a rushing muffled sort of noise from E. to W.
945. Do.—Mr. B. S. Penley. 3. 5.33. 4. only one series. 5. ab. 10 secs. 6. < 4. 7. the passing of some heavy vehicle, but it was too loud for that. b. p. c. pr. p.
946. Do.—(*Bristol Observer*, Dec. 19.) 3. 5.30. 4. two sha., the first a gentle trembling, the second more pronounced and of greater duration. 6.

947. Do.—Mr. T. Sherlock* (*Bath Argus*, Dec. 19). 3. 5.30. 4. a violent oscillation, the bed heaving. 6. 7.

948. Do.—Anon.* (*Bath Argus*, Dec. 19). 3. 5.35. 4. the bed rose and fell for several secs. 6. 5.

949. Do.—Rev. W. H. H. Cooper (*Daily Telegraph*, Dec. 18). 4. two distinct shs. at an interval of a few secs. 6. 5.

950. Do.—Mr. D. Young (*Daily Telegraph*, Dec. 18). 4. a wavy motion of the bed. 6. 5. 7. the sh. acc. by a low distant rumbling so.

951. Do.—(*Daily Telegraph*, Dec. 18.) 3. 5.30. 6. pr. 6.

952. *Beckington*.—Rev. T. E. L. Sainsbury. 3. ab. 5.30. 4. a trem. mot. 7. a rumbling so, like a traction-engine passing, heard by other observers.

953. *Bedminster*.—(*Birmingham Daily Gazette*, Dec. 18.) 6. a lamp was thrown off a bracket.

954. *Bishops Hull*.—Mr. J. H. Manley. 3. ab. 5.31. 4. b. 4 vibra. c. yea. f. yea. g. W. to E. 5. ab. 20 secs. 6. 5. 7. no so. during the sh., but, after it ceased, a so. as of strong wind passing through leafy trees.

955. *Blagdon*.—(*Bristol Observer*, Dec. 19.) 3. ab. 5. 6. pr. 5.

956. *Bleadon*.—Mr. F. Poole. 3. 5.35. 4. one sh. like that felt when standing on a threshing-machine driven at full speed. f. yea. 5. ab. 5 secs. 6. 5. 7. distant heavy thunder, lasting ab. 5 secs, app. from the S.W.; the end of the so. p. the beg. of the sh. by ab. 1 sec.

957. *Bridgwater*.—Mr. N. H. C. Ruddock.* 4. the bed vibrated, the last 2 vibra. being more distinct, longer apart and more jerky. g. N. to S. 5. ab. 12 or 15 secs. 7. no.

958. *Burnham Lighthouse*.—Mr. W. G. Graham,* on watch in the lantern at an elevation of ab. 110 ft. 3. ab. 5.30. 4. several slight shs., causing slight vibr. of the tower.

959. *Castle Cary*.—Mr. J. Hayward. 3. 5.35. 4. a. very slight. b. one series. c. slight. d. yea. e. mid. f. no. 6. 5. 7. a traction-engine in the distance. b. pr. c. c. c. f. no.

960. Do.—(*Bristol Observer*, Dec. 19.) 3. ab. 5.30. 7. a faint rumbling noise, as of some heavy vehicle, acc. the sh.

961. *Chard*.—(*Somerset County Herald*, Taunton, Dec. 19.) 6. 5? 7. a rumbling so.

962. *Chew Stoke*.—Rev. W. A. Shilcock.† 3. 5.34.* 4. 2 or 3 vibra., wh. shook the bed as if a giant were rocking it. g. E. and W. 5. ab. 3 or 4 secs. 6. 5. 7. other observers heard a rumbling so. before they felt the sh.

963. *Cheddar*.—Mr. R. Brown (*Avalon Independent*, Glastonbury, Dec. 24). 3. 5.35. 4. a rocking movement. 5. ab. $\frac{1}{2}$ min. 6. 5. 7. the sh. acc. by a humming noise.

964. Do.—(*Bristol Observer*, Dec. 19.) 3. 5.40. 6. pr. 5.

965. *Chewton Mendip*.—Rev. C. Young.* 3. 5.35. 4. the bed seemed to be raised, then after ab. a min. there was a slight trem. mot. 6. 5. 7. no.

966. *Clevedon*.—Mr. W. Price.* 3. 5.35. 6. 4.

967. Do.—(*Bristol Observer*, Dec. 19.) 3. ab. 5.30. 5. several secs. 6. 5.

968. *Combe St. Nicholas*.—(*Bristol Observer*, Dec. 19.) 7. the sh. acc. by a rumbling noise as if stones were being shaken together.

969. *Corfe*.—Mr. J. H. Spencer. 3. ab. 5.37. 4. the bed shook, as if by some one walking heavily across the floor. 6. 5? 7. no.

970. *Crewkerne*.—(*Somerset County Herald*, Taunton, Dec. 19.) 6. 5? 7. rumbling so.

971. *Evercreech*.—The Hon. Mrs. Talbot.† 4. c. yes e. mid. f. yes (according to other observers). 6. 5. 7. the rolling of a lawn by an extremely heavy roller (according to another obs.).

972. *Failand House*.—Right Hon. Lord Justice Sir E. Fry, F.R.S.† 3. 5.33.* 4. app. a shove or push of the bed from W. to E., with no vert. mot. and no return mot. 7. no.

973. *Do*.—Miss J. M. Fry.† 3. 5.35. 4. as if the bed had been seized and shaken up and down, as if on the edge of a saw. 5. ab. 10 secs. 6. 5.

974. *Do*.—Mr. E. P. Fry.* 3. pr. 5.33. 4. one series, wh. incr. until the walls of the room seemed to flutter. c. no. f. no. 6. pr. 5. 7. a carriage driven very heavily, the noise approached in increasing force for ab. 5 secs. from W.N.W. b. p. ab. 5 secs. c. f. ab. 1 or 2 secs. d. yes. e. p. the instant when the so. was loudest imm. p. the beg. of the sh. f. yes.

975. *Freshford*.—Mr. A. S. Clarke.† 3. ab. 5.30. 4. the bed rocked gently. 6. 5. 7. three gentle rumbles after the sh. at intervals, as if a distant train were passing.

976. *Glastonbury*.—Mr. P. Black. 3. 5.37. 4. 5 or 6 undulatory vibra. 5. 5 or 6 secs. 6. 5. 7. a heavy dray or steam-roller passing along a silent street; the noise ended suddenly with a thud as if a heavy stone had fallen. b. c. c. c.

977. *Henstridge*.—E. A. Scammell. 3. ab. 5.45. 4. the bed gently oscillated. 5. several secs. 6. pr. 5. 7. no.

978. *Holford*.—J. E. Joseph.* 3. 5.30. 4. the bed heaved and shook violently from side to side. g. N. to S. 6. 5. 7. a slight so. like the first internal rumbling of a kettle about to boil, succeeded imm. by a loud noise increasing in int. as it app. came nearer, more like a dozen schoolboys with heavy boots tearing upstairs and upsetting each other, but speechless, than anything else; imm. the bed heaved; the so. seemed to travel from N. to S.

979. *Horton*.—E. J. J. Rogers.† 3. 5.30. 5. ab. 2 or 3 secs. 6. < 4. 7. the sh. acc. by a noise like that of an express train going through a station.

980. *Huntspill*.—(*Avalon Independent*, Glastonbury, Dec. 24.) 3. ab. 5.45. 5. several secs. 6. < 4.

981. *Huntworth*.—Mr. H. S. B. Goldsmith* (*Standard*, Dec. 18.) 3. 5.39. 4. 7 or 8 oscillations from N. to S., f. by some slighter vibra. 5. ab. 6 or 7 secs. 6. < 4. 7. no.

982. *Ilchester*.—Rev. W. D. H. Armstrong.* 3. 5.34. 5. ab. 3 secs. 6. pr. 5. 7. a rumbling so., like that of a heavy load passing along the road, p. the sh.

983. *Ilminster*.—Mr. R. T. Walter.† 4. b. 3 vibra. for as many secs. c. yes. d. the movement grad. died away. e. mid. f. yes. 5. ab. 6 secs. 6. pr. 5. 7. no.

984. *Keynsham*.—Mr. T. S. Smith.* 3. 5.34. 4. an upheaval, f. by a sudden recoil and trem. vibra. 5. ab. 10 secs. 6. 5. 7. a noise like

that of a very heavy person falling, then a swishing noise like wind, f by the upheaval; no so. after the first movement.

985. *Kingston*.—Rev. A. G. Tomlin.† 3. 5.40. 5. several secs. 6. pr. 5. 7. some of the villagers heard a so.

986. *Kingston Seymour*.—Rev. G. H. S. Pigott. 3. 5.44. 4. a. yes, 15 secs. b. two series, 9 secs. and 6 secs. c. yes, 8 secs. d. yes. e. mid. f. yes. 6. 5. 7. a cart at the foundations. b. p. 5 secs. c. p. d. yes. e. p. f. yes.

987. *Knowle*.—Mr. H. C. Owen (*Bristol Observer*, Dec. 19). 3. 5.34. 4. g. E. to W. 5. 10 to 12 secs. 6. < 5.

988. *Long Ashton*.—(*Bristol Observer*, Dec. 19.) 3. bet. 5.30 and 5.40. 5. ab. 4 secs. 6. < 4.

989. *Martock*.—Mr. M. J. Rickcord. 3. 5.37. 4. a very distinct undulating motion. 5. ab. 10 secs.

990. *Do*.—(*Somerset County Herald*, Taunton, Dec. 19.) 5. several secs. 6. 5?

991. *Milborne Port*.—(*Somerset County Herald*, Taunton, Dec. 19.) 4. sh. felt. 7. a rumbling noise.

992. *Nailesea*.—Rev. J. Johnson. 3. 5.30. 6. 5? 7. a slight rumbling so, like the approach of a distant traction-engine.

993. *North Cadbury*.—Rev. H. A. Boys† (*Morning Post*, Dec. 19). 3. 5.31. 4. two successive waves, following hard one on the other; the movement nearly horizontal.

994. *North Perrott*.—(*Somerset County Herald*, Taunton, Dec. 19.) 3. ab. 5.30. 6. 5?

995. *Oaklands*.—Mrs. Gifford.* 3. ab. 6.35 [*sic*]. 4. two series, the second stronger, interval bet. them pr. 3 or 4 secs.; the first a shivering motion; during the second, wh. lasted ab. 4 or 5 secs, the bed distinctly rocked ab. 6 to 8 times from side to side. g. E. and W. 6. 5. 7. no.

996. *Paulton*.—Mr. J. Adams.* 3. 5.33.* 4. ab. 4 vibrs, a gentle swaying to and fro, acc. by a slight trem. mot. 5. 4 secs. 6. 5. 7. a rustling so. acc. the sh. c. c.

997. *Porlock*.—Mrs. W. Hook. 3. 5.35. 4. two separate sets of vibrs, both very distinct, ab. 5 secs. bet. them. 5. the first ab. 3 secs, the second less. 6. 4. 7. no.

998. *Portishead*.—(*Bristol Observer*, Dec. 19.) 3. 5.20. 6. < 5.

999. *Priston*.—Rev. T. H. Hollier. 3. 5.30. 6. < 5. 7. a rumbling noise, like that of a heavily-laden waggon, f. by the sh.

1000. *Publow*.—Miss H. T. Bellamy.† 3. 5.32. 4. bed raised and shaken. 5. ab. 20 secs. 6. 5. 7. no.

1001. *Radstock*.—Mr. S. L. Harvey.* 3. pr. 5.30. 4. 5 distinct vibrs. g. N. and S. 5. 5 secs. 6. 5. 7. a distant rumbling with the sh.

1002. *South Petherton*.—Mr. H. Norria.† 3. ab. 5.34. 4. a kind of lurch, f. by a sensible vibr. 5. ab. 10 secs.

1003. *Street*.—(c. by Mr. J. E. Clark.) 3. 5.35. 4. the vibr. like that caused by a steam-roller passing. 6. pr. 4.

1004. *Do*.—(*Avalon Independent*, Glastonbury, Dec. 24.) 3. ab. 5.30. 6. pr. 5.

1005. *Taunton*.—Mr. W. H. Sanders. 3. ab. 5.35. 4. vibrs. like that

in a cart driven rapidly over stones, ab. 15 secs, then a severe sh. f by slight vibra. 6. 5.

1006. *Theale*.—Rev. J. S. F. Singleton. 3. 5.30. 6. 5.

1007. *Trull*.—(*Somerset County Herald*, Taunton, Dec. 19.) 3. ab. 6. 5. ab. 30 secs. 6. 5?

1008. *Wedmore*.—(c. by Rev. S. H. A. Harvey.) 3. soon after 5.30. 6. 5.

1009. *Wellington*.—Mr. W. P. Martin, jun.† 3. ab. 5.35. 6. 5. 7. a traction-engine passing. c. p. several secs.

1010. Do.—Mr. Harkell* (c. by Mr. W. G. Hole). 3. 5.34.* 4. a trem. mot. accompanying two prin. vibra. wh. incr. and then died away. 5. 7 or 8 secs. 6. < 4. 7. a so. as of a rushing wind p. the vibra.

1011. Do.—Anon.* 5. several secs. 6. 5.

1012. *Wells*.—Mr. E. H. Hippiasley.† 3. 5.33. 4. the motion like that felt on board ship. 5. < 5 secs. 6. 5. 7. no.

1013. *Weston* (near Bath).—(*The Times*, Dec. 18.) 6. 6.

1014. *Weston-super-Mare*.—Mr. A. C. Stanton.* 3. ab. 5.30. 4. the bed swayed to and fro, from E. to W., quickly and in a very marked way at first, but grad. more slowly and faintly till it ceased. 5. 2 or 3 secs. 6. 5. 7. a peculiar noise like a sudden rush of wind, and shortly after it ceased the bed began to sway.

1015. Do.—Mr. W. G. Lax.† 3. 5.32. 4. a deliberate shaking, perfectly horizontal. 5. ab. 3 or 4 secs. 6. pr. 5. 7. no.

1016. Do.—Mr. J. P. Page.† 4. g. N. to S. or N.N.E. to S.S.W. 6. 4. 7. a steam-roller passing, but much louder; the so. ceased suddenly.

1017. Do.—(*Weston Mercury*, Dec. 19.) 3. 5.35. 5. ab. 4 or 5 secs. 6. 5. 7. a rumbling noise like thunder, wh. seemed to pass away like a low moaning wind.

1018. *Wincanton*.—Rev. W. Farrer.† 3. 5.34. 4. the motion chiefly lateral. 6. < 4.

1019. Do.—(*Somerset County Herald*, Taunton, Dec. 19.) 3. ab. 5.40. 6. 5? 7. a rumbling noise.

1020. *Woolverton*.—E. K. Burdett. 3. 5.26. 5. ab. 10 secs. 6. < 4. 7. a very slight rumbling so. acc. the sh. during the last 2 or 3 secs.

1021. *Wrington*.—(*Bristol Observer*, Dec. 19.) 6. 5.

1022. *Yeovil*.—Mr. J. Trevor-Davies* (*Somerset County Herald*, Taunton, Dec. 19.) 3. 5.36. 4. a slight tremor, and imm. afterwards a very distinct undulatory movement of the earth acc. by a lifting sensation. 6. 5. 7. a deep rumbling so. as if a traction-engine were coming along the street some distance off: f. by the tremor.

1023. Do.—(*Bristol Observer*, Dec. 19.) 3. ab. 5.30. 6. pr. 5. 7. a rumbling noise.

WILTSHIRE

1024. *Beckhampton*.—Mr. E. A. Willis. 5. ab. 5 secs. 6. no.

1025. *Berwick St. John*.—I. G. Wilkin.† 3. ab. 5.30 A.M. 4. two max. of int., the first stronger. 6. pr. 5.

1026. *Biddeston*.—Rev. J. A. Johnson.† 3. ab. 5.35. 6. < 4. 7. so. heard.

1027. *Bishopstone*.—Anon.* (c. by Rev. H. Ault). 3. 5.30. 4. a. yes, 20 secs. b. one series, 25 secs. c. yes, 25 secs. d. yea. e. mid. f. yes. g. N. to S. 6. 5. 7. a heavy vehicle passing. b. p. 20 secs. c. p. d. yes. e. p., the sh. f. imm. f. no [the observations under the last heading probably refer to the prin. vibra. and not to the trem. mot. which p. and f. them].

1028. Do.—Mr. J. Chivers. 3. 5.30. 4. one sh., a distinct upheaval from N. to S. 5. 25 secs. 6. 5. 7. no.

1029. *Box*.—Mr. A. F. Perren* (*Wiltshire Times*, Trowbridge, Dec. 19). 3. ab. 5.30. 6. 5. 7. a deep rumbling noise like that of a passing train. b. p.

1030. *Bradford-on-Avon*.—Lord E. Fitzmaurice † (c. by Mr. W. Heward Bell, F.G.S.). 4. a vibratory mot. f. no. 6. pr. 5. 7. no.

1031. Do.—Anon. 3. 5.30. 4. one continuous sh. g. N. and S. 5. bet. 8 and 10 secs. 6. 5. 7. a heavy luggage-train or rattling of iron bars. b. c. c. c.

1032. Do.—(*Marlborough Times*, Dec. 19.) 5. 10 secs. 6. 5.

1033. *Brinkworth*.—Mrs. Hitchcock.† 4. bed shaken and app. raised from N.W. end. 6. 5. 7. no.

1034. *Broad Hinton*.—Rev. R. C. Crokat. 3. ab. 5.30. 6. 5. 7. the obs. thinks he heard a slight rumble, as of thunder, imm. after the sh.

1035. *Calne*.—Miss S. S. Harris † (c. by Mr. J. Thudgate). 3. 5.30. 6. 5? 7. no.

1036. *Castle Combe*.—(*Wiltshire Times*, Trowbridge, Dec. 19.) 3. 5.30. 6. 5. 7. a great rumbling noise.

1037. *Charlton*.—Mrs. Collins † 3. 6.20 [sic]. 4. a trem. mot., the crockery in the room rattled twice, with a few seconds' pause between. 6. < 4. 7. no.

1038. *Chippenham*.—Mrs. Roach.* 3. ab. 5.30. 4. the int. nearly the same throughout. f. yes. g. E. to W. 5. ab. 20 to 30 secs. 6. the panes of glass were cracked on the window sash. 7. a rumbling so. like thunder underground.

1039. Do.—(*Wiltshire Times*, Trowbridge, Dec. 19.) 4. the motion as if a steam-roller or traction-engine passed along the street. 5. ab. 30 secs. 6. 6. 7. the sh. acc. by a rumbling noise.

1040. *Chittoe*.—Rev. H. H. Mogg † (c. by Mr. W. Heward Bell, F.G.S.). 3. 5.32. 6. < 4.

1041. *Chyffe Pypard*.—Rev. E. A. Goddard † (c. by Mr. W. Heward Bell, F.G.S.). 3. 5.35. 5. ab. 2 or 3 secs. 6. 5. 7. the obs. believes that, as he woke, he heard the end of the rumbling so. like a train passing.

1042. *Compton Park*.—Mr. C. Penruddocke, J.P., D.L. 3. 5.30. 4. the movement of a wave-like nature with something of an upward tendency. g. N. to S. 5. a few secs. 7. no, but another obs. heard with the sh. a noise like wind through trees.

1043. *Corsham*.—Mr. H. Brakspear (c. by Mr. W. Heward Bell, F.G.S.). 3. ab. 5.35. 4. the vibra. seemed of equal int. g. N. and S. 5. ab. 5 secs. 6. 5. 7. a loud rumbling like a heavy vehicle passing along the road; the so. p. the sh.

1044. *Cricklade*.—Rev. J. McKaye. 3. bet. 5.40 and 5.45. 5. a few secs. 6. 6.

1045. *Devizes*.—Mr. E. T. Simpson * (c. by Mr. J. C. Neville). 3. 5.35. 4. trem. mot. ab. 10 secs, a very slight interval, then strong upheaval, ab. 10 secs. e. end. 6. 5. 7. a distant traction-engine. b. p. a few secs. c. p. 20 secs. d. yes. e. p.

1046. *Do*.—Rev. F. E. Skyrme * (c. by Mr. W. Heward Bell, F.G.S.). 3. 5.33. 5. ab. 2 or 3 secs. 6. < 4. 7. no.

1047. *Do*.—Mrs. Smith (Old Park). 3. ab. 5.30. 6. 5. 7. no, but another obs. heard a rumbling noise, as if a waggon were passing, till it disappeared in the distance.

1048. *Downton*.—Mr. G. H. Dunmore. 3. 5.40. 4. the sh. consisted of two parts, separated by a sec. or two, the second part stronger. 5. ab. 10 secs. 6. 5. 7. the fall of a heavy body with explosion. b. c. c. p.

1049. *Grittleton*.—Sir A. W. Neeld, Bart.* 3. 5.35. 4. very strong trem. mot., the bed seemed to oscillate from side to side many times in 2 secs.; the whole house then rocked distinctly 6 or 7 times from E. to W. for ab. 2 secs., the movements regular and horizontal. 5. ab. 4 secs. 6. 5. 7. a so. as of a rushing mighty wind, app. from N. or N.W., p. the sh. imm. and lasted ab. 3 secs.

1050. *Hankerton*.—Rev. W. J. Buckland.† 3. 5.40. 4. two max. of int. f. yes. g. nearly N. to S. 6. 5. 7. as if a strong wind had blown through the lower part of the house and had slammed the doors.

1051. *Heytesbury*.—Rev. W. J. Swayne.* 3. 5.35. 4. two brief vibra. or sha, with an interval of a sec. bet. them, the first stronger; the sh. resembled the jolt with wh. a berth at sea moves when the ship rolls rather sharply. g. E. to W. 5. ab. 4 secs. 6. pr. 5.

1052. *Hilperton*.—(*Wiltshire Times*, Trowbridge, Dec. 19.) 6. 5.

1053. *Holt*.—Anon. 3. 5.35. 4. as if some one under the bed lifted it up and swayed it; the window violently shaken, then a pause of a few secs., the same occurring twice more, the last part strongest. 5. ab. 30 or 40 secs. 6. a photograph-frame was thrown from a mantelpiece, and a tray in the kitchen knocked down. 7. a traction-engine. b. f. almost imm. c. f.

1054. *Do*.—Mr. E. C. Beavan † (c. by Mr. W. Heward Bell, F.G.S.). 3. 5.24. 4. b. one series, 2 secs. c. yes, 2 secs. e. beg. f. no. 6. a tray leaning against the window was knocked down.

1055. *Inglesham*.—Rev. G. W. Spooner.† 4. 5 or 6 prin. vibra. grad. dying away. 5. ab. 8 or 10 secs. 6. 5. 7. thunder; the so. c. with the sh.

1056. *Kemble*.—Rev. R. H. Taylor. 3. 5.30. 4. 3 series. f. yes. 5. perhaps a min. 6. < 5. 7. the roll of a waggon, the so. p. the sh.

1057. *Latton*.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 5. 2 or 3 secs. 6. 5.

1058. *Little Somerford*.—Anon.* (c. by Rev. R. G. Brown). 3. 5.30 or 5.31. 4. two series. 5. nearly a min. 6. 5. 7. rushing water (according to another obs., like a chimney falling).

1059. *Ludgershall*.—Rev. W. H. Awdry. 3. 5.30. 6. 5 ?

1060. *Lydiard Tregoz*.—Rev. H. G. Bailly.* 3. 5.32. 4. two distinct

sha. g. S. to N. 5. 2 or 3 secs. 6. 5. 7. a passing goods-train on a frosty night.

1061. *Malmesbury*.—(*Marlborough Times*, Dec. 19.) 5. a few secs. 6. 5? 7. the sh. acc. by noise.

1062. *Marlborough*.—Mr. V. Head. 3. 5.35. 4. 3 sha, ab. 2 secs. between each, the second weaker than the others. g. E. to W. 5. quite 30 secs. 6. 6. 7. a loud so. wh. seemed to increase very much; at the beg. a hollow so, but after ab. 3 secs. the hollow so. and a rumbling noise combined, left off, during the last 8 secs., with a loud rumbling noise like a heavy roller going at a rapid pace; duration of so. 35 secs.

1063. Do.—Mr. W. S. Bambridge.† 3. ab. 5.30. 4. four series, each containing 4 liftings, each series lasting a sec. and succeeded by a pause for $\frac{1}{2}$ a sec. 5. ab. 6 secs. 6. 5.

1064. Do.—Rev. H. R. Whytehead (*Marlborough Times*, Dec. 19). 3. 5.35. 4. five sha. f. yes. 6. 5. 7. a rumbling noise.

1065. *Melksham*.—Miss M. Stratton † (c. by Mr. W. Heward Bell, F.G.S.). 3. ab. 5.30. 4. [app. two series of vibra.] e. end. f. no. 6. 5. 7. a rumbling so. with the vibra.

1066. *Minety*.—(*Wiltshire Times*, Trowbridge, Dec. 19.) 3. 5.33 $\frac{1}{2}$. 6. 5.

1067. *Monkton Deverill*.—Mr. F. J. Carey.* 3. 5.35. 5. ab. 3 secs. 6. < 4. 7. a howling rumbling noise, wh. lasted 3 secs. and seemed to die away.

1068. *Monkton Farleigh*.—Sir C. P. Hobhouse, Bart.† 3. ab. 5.30. 5. perhaps 20 to 30 secs. 6. < 4. 7. a heavy waggon passing along the drive.

1069. *New Swindon*.—Mr. C. Preston.* 3. 5.35 or 5.36. 4. two parts of equal int., interval $\frac{1}{2}$ sec. 5. ab. 5 secs. 6. < 4. 7. a steam-roller or traction-engine passing. b. c.

1070. *Oaksey*.—Rev. W. J. H. Faithfull† 3. 5.35. 4. a violent lateral oscillation, like the shaking of a sieve, dying away towards the end. g. N. to S. 5. 20 secs. 6. 6. 7. no; the sh. was felt by nearly every one, but only two persons heard the so., a rumbling, crashing, grating so.

1071. *Poole Keyne*.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 6. 5.

1072. *Potterne*.—Rev. C. H. Cooke † (c. by Mr. W. Heward Bell, F.G.S.). 3. 5.39. 5. 8 to 10 secs. 6. 5. 7. a steam-roller on frozen ground ab. 100 yards away.

1073. *Ramsbury*.—(c. by Mr. F. C. Batson.) 3. 5.38. 4. a tremor, f. by a rocking. 5. 3 secs. 6. pr. 5. 7. a load of stones shot out of a waggon.

1074. *Salisbury*.—Mr. O. P. Fisher.* 3. ab. 5.15 to 5.30. 4. a series

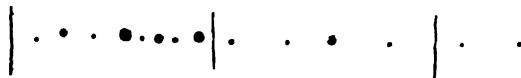


FIG. 8.

of vibra. represented in intensity and distance apart by the dots. 5. 2 to 3 secs. 7. a slight rumbling acc. the first part of the sh.

1075. Do.—S. Bolton.* 3. ab. 5.35 or 5.37. 4. the bed lifted 4 or 5

times as if some one were beneath. 6. 5. 7. a curious rustling so, quite distinct from an ordinary gust of wind, at the same time as the sh.

1076. Do.—Mr. W. E. Cosser.† 6. 4. 7. no.

1077. *Seagry*.—Mr. A. Cotes.† 3. 5.28. 4. the bed shaken as if by a strong man holding on to the end. g. S. to N. 5. ab. 2 to 3 secs. 6. 5. 7. a rumbling noise at the time of the sh.

1078. *Shrewton*.—(c. by Rev. C. V. Goddard.) 6. 5. 7. a waggon passing.

1079. *Somerford Keynes*.—Rev. W. Fawcett.* 4. the vibra. greatly resembled those made in a building by a heavy train passing close by. 5. ab. 2 or 3 secs. 6. 5. 7. no.

1080. *South Wrazall*.—Rev. O. M. Grindon.† 3. ab. 5.32½. 4. (according to another obs.) a vibratory sh, wh. was distinctly and more intensely repeated in ab. 30 secs. 6. 5. 7. a prolonged rumbling, like the passage of a steam-roller.

1081. *Stanton St. Quintin*.—Rev. Canon F. J. Buckley. 3. ab. 5.30. 4. a. yes. b. several, not more than 1 sec. c. no. d. only one series. 6. 6.

1082. *Stratton St. Margaret*.—Rev. C. F. Burgess.† 4. continuous motion. f. no. g. E. to W. 5. ab. 5 or 6 secs. 7. a rumbling so, like a traction-engine passing, at the same time as the trembling.

1083. *Trowbridge*.—Mr. P. L. Hill. 3. 5.30. 4. the vibr. similar to that felt when a traction-engine passes down the street. 5. ab. 20 secs. 6. < 5.

1084. Do.—Mr. W. Walker † (c. by Mr. W. Heward Bell, F.G.S.). 6. 5. 7. no.

1085. Do.—Anon.† (*Wiltshire Times*, Trowbridge, Dec. 19.) 3. ab. 5.30. 7. a passing sough of wind, the so. p. the sh.

1086. Do.—(*Wiltshire Times*, Trowbridge, Dec. 19.) 6. < 4. 7. a traction-engine passing, but more pronounced.

1087. *Warminster*.—Mr. E. W. Ormerod † (c. by Mr. H. Ormerod). 3. 5.20. 4. b. ab. 4 secs. c. yes, ab. 2 secs. d. the movement grad. died away. 5. ab. 6 secs. 6. 5. 7. a traction-engine passing.

1088. Do.—(*Wiltshire Times*, Trowbridge, Dec. 19.) 6. < 4. 7. a deep rumbling noise acc. the sh.

1089. *Westbury*.—Mr. A. E. Niblett.* 3. 5.35. 4. a wavy motion. 5. 6 or 7 secs. 6. 5.

1090. Do.—(*Somerset County Herald*, Taunton, Dec. 19.) 3. ab. 5.35. 5. ab. 2 secs. 6. 5? 7. no.

1091. *Wootton Bassett*.—Rev. W. E. Cockshott. 3. ab. 5.30. 6. < 4. 7. no.

1092. *Worton*.—Mr. J. Musselwhite (c. by Mr. W. Heward Bell, F.G.S.). 3. 5.30. 4. a. yes, ab. 2 or 3 secs. b. 5 distinct vibra. c. yes, ab. 2 secs. d. yes, only one max. e. mid. f. yes. 6. 5. 7. a heavy waggon approaching over stones from W. to E. b. p. ab. 2 secs. c. f. d. yes.

1093. *Yatesbury*.—Miss J. Munce* (c. by Rev. E. D. Guilleband). 3. ab. 5.30. 4. a continuous trem. mot., very slight at first, increasing grad., prin. vibra. at end, no interval of quiet. 5. more than a min. 6. 5. 7. no.

BERKSHIRE

1094. *Abingdon*.—(*Oxford Journal*, Dec. 19.) 6. 6. 7. a low rumbling noise f. by a convulsive movement of the earth.

1095. *Do*.—(*Oxford Chronicle*, Dec. 19.) 6. 4 5. 7. a rumbling noise f. by a distinct trembling of the earth.

1096. *Ascot Heath*.—B. Ellis† 3. 5.30 A.M. 5. 12 to 20 secs. 6. 5. 7. a sudden hurricane in the room, at the same time as the shaking.

1097. *Binfield*.—Mr. W. Walker.† 4. the bed lifted up bodily as if some one were underneath it, then a rumbling noise during wh. there was a violent rattling of crockery, etc. 6. 5. 7. as if some heavy weight were dragged over the floor, the so. p. and f. the rattling of crockery.

1098. *Bracknell*.—Mr. C. J. Cave.* 3. ab. 5.30. 4. only one sh., as if some one who had hold of the foot of the bed were shaking it rather violently. 6. 5? 7. no.

1099. *Brightwalton*.—Rev. H. F. Howard.† 3. 5.30. 6. 4 5; cracks made in two inner walls, 9 ins. thick. 7. a so. as if some one had fallen against the door with a dull thud.

1100. *Buckland*.—Anon.† (c. by Rev. W. Bulmer). 3. ab. 5.30. 6. 5.

1101. *Coleshill*.—Mr. W. B. Barington. 3. 5.45. 4. only one sh., a severe shaking of the bed as if a man underneath were upheaving it. 5. 2 or 3 secs. 6. 5. 7. no.

1102. *Compton Beauchamp*.—Miss F. C. Pope. 3. 5.30. 4. a. yes (by other observers). b. the bed moved and then fell back into place, as if pushed violently and quickly from behind the head, i.e. from E. 6. 5. 7. no rumbling, only one sharp and rather loud report as if a heavy door had been banged.

1103. *Cumnor*.—Rev. S. Y. N. Griffith.† 3. bet. 5.30 and 6. 6. 4 4. 7. no.

1104. *Didcot*.—Mr. H. P. Brown.† 3. 4.30 [*sic*] 4. f. yes. 5. only a few secs. 6. 5.

1105. *East Garston*.—Anon.* 3. 5.30. 6. 5.

1106. *East Ilsley*.—Rev. T. R. Terry, F.R.A.S.† 6. 5. 7. as if 3 or 5 men had simultaneously shot sacks of coal from their backs on to the floor of the next room.

1107. *Faringdon*.—(*Swindon Advertiser*, Dec. 26.) 3. ab. 5.30. 5. some secs. 6. 5?

1108. *Fernley*.—Mr. W. Butler (c. by Capt. J. Fitzmaurice, R.N.). 3. 5.30 or 5.31. 5. 2 or 3 secs. 6. 5. 7. the rumbling of a traction-engine. b. c. c.

1109. *Fyfield House*.—Lieut.-Col. F. Clayton.† 3. 5.39. 4. 4 or 5 horizontal movements from E. to W. 5. ab. 30 secs. 6. pr. 5. 7. no.

1110. *Great Coxwell*.—Rev. R. H. Hooper.† 7. as if a heavy person were walking across the room in list slippers.

1111. *Hoe Benham*.—(Three observers in different houses under one roof, all asleep.) 4. g. E. to W. 5. ab. 60 secs. 6. pr. 5. 7. no.

1112. *Holyport*.—Mr. A. B. Basset, F.R.S.* 3. ab. 5.30. 4. two tremors,

like the motion produced by a railway-train when travelling through a tunnel upon the ground above. 5. 2 or 3 secs. 6. pr. 4. 7. no.

1113. Do.—Mr. J. A. Brangwin.† 3. 5.35. 4. two series.

1114. *Knitbury*.—Mr. F. C. Batson.† c. yes, slight. g. S.E. to N.W. ? 5. ab. 2 secs. 6. 5. 7. a train in underground railway. c. c.

1115. *Letcombe Bassett*.—Miss S. A. Woodford.† 3. ab. 5.30. 4. the bed violently shaken.

1116. *Longworth*.—Rev. J. R. Illingworth.† 3. ab. 5.30. 4. a trem. movement. 7. a noise heard. c. p.

1117. *Maidenhead*.—Anon.* (c. by Rev. C. H. Nash). 3. ab. 5.30. 4. f. yes. 6. 5.

1118. *Mortimer Stratfield*.—Mr. F. H. Pearce.† 3. 5.33. 4. a. no. b. 3 prin. vibra, ab. 1 sec. each, diminishing in int. f. yes. 5. < 3 secs. 6. 5. 7. no.

1119. *Newbury*.—Mr. W. T. Catleugh.* 3. 5.27. 4. a quivering movement of uniform int. 5. 15 secs. 6. < 4. 7. no.

1120. Do.—Mr. D. Bosley.* 3. ab. 5.35. 4. g. W. to E. 5. several secs. 7. a so. as of a terrific gale, it seemed to stop at the house and then there was a great shaking.

1121. Do.—Mr. T. H. Stillman.* 3. 5.35. 4. a great rattling of windows and imm. afterwards two rapid jerks, as though the bed had been quickly lifted, the W. side rising first. 6. 5.

1122. *Oakley Court*.—Mr. H. Lea.* 3. ab. 5.35. 4. two shs, ab. 2 secs. apart, the second by far the strongest, the first lasting ab. 10 secs, causing a loud rattling of a jug in a wash-hand basin; the second, ab. 1 sec., moved the bed sideways, once to E. and back to W. 5. ab. 13 secs. 6. 5. 7. no.

1123. *Reading*.—Mr. J. L. Hawkins.† 3. 5.32. 4. a gentle but rapid rocking from side to side; the obs. jumped out of bed and turned up the gas and, while doing so, he felt an unstable oscillatory sensation. 5. ab. 10 to 15 secs [the first sh.]. 6. 5. 7. no.

1124. Do.—Miss N. Lea.† 3. ab. 5.33. 4. the bed rocked violently; after ab. 2 secs. a heavy thumping so., as if some person or persons carrying a heavy burden were walking across a room overhead. 6. 5.

1125. Do.—Mr. T. H. Parson.† 3. just after 5.30. 5. ab. 5 secs. 7. the heavy moving of persons overhead.

1126. Do.—Mr. O. A. Shrubsole, F.G.S.† 3. 5.31½. 5. a few secs. 6. 5.

1127. Do.—Mr. J. Sparrow.* 3. 5.33½. 4. ab. 6 or 7 shakes, the bed moving ab. ½ an inch app. from W. to E. 6. 5.

1128. Do.—(*Reading Mercury*, Dec. 19.) 3. bet. 5.30 and 5.35. 4. g. W. to E. 6. pr. 6; several light articles of furniture and wall-pictures were displaced, and in a very few cases china and glass were broken. 7. a hollow rumbling noise like that made by a traction-engine or waggon passing over a bridge: some compared the noise to that of a high wind in chimneys; the noise was unnoticed by many who distinctly felt the sh.

1129. Do.—(*Reading Mercury*, Dec. 19.) 3. ab. 5.35. 4. two distinct shs., the second stronger and quickly succeeding the first. 6. 5 or 6. 7. a rumbling noise.

1130. *Remenham*.—Mr. C. Holloway* (c. by Mr. C. J. Barnett). 3. 5.32. 4. g. W. to E. 7. a rushing wind or dull roar, lasting 3 or 4 secs.

1131. *Shaw*.—Anon.* (c. by Mr. R. Lovelock). 3. bet. 5.30 and 5.35. 4. two series, the first a tremor; f. not many secs. after by the second wh. uplifted the bed and set all loose things in the room jingling. 6. 5. 7. a so. with the first tremor.

1132. *Shrivenham*.—Anon.† 4. c. yes. d. yes. f. yes. 6. < 5. 7. distant thunder. b. c. d. no.

1133. *Speen*.—(c. by Rev. R. C. Edwards.) 3. 5.28 to 5.30. 4. f. yes. 6. 5. 7. (according to other observers) a considerable rumbling noise p. and acc. the sh.

1134. *Thatcham*.—Rev. D. Peirce.† 3. 5.30. 4. a trem. mot. 7. acc. by a rumbling as of very deep thunder.

1135. *Twyford*.—(c. by Mr. Ll. Treacher.) 3. shortly after 5.30. 6. pr. 5. 7. a rustling so. like a sudden gust of wind.

1136. Do.—(*Reading Mercury*, Dec. 19.) 3. ab. 5.40. 4. a most decided rocking felt, wh. lasted for several secs, and was repeated after an interval of 5 mins. [sic]. 6. 5.

1137. *Wallingford*.—Rev. F. T. S. Dyer.† 3. bet. 5.20 and 5.30. 4. b. 3 or 4 secs. c. yes, 4 to 5 secs. f. no. 6. 5. 7. in one or two cases, a rumbling was heard before the sh.

1138.—*Wantage*.—Mr. A. S. Kent.* 3. ab. 5.10. 4. the bed appeared to shift on its castors ab. an inch 3 times; two series, separated by ab. 1½ mins, perhaps less, the first much the stronger. 5. ab. 5 secs. 6. 5. 7. no.

1139. Do.—Miss M. A. Butler.† 3. just after 5.30. 6. pr. 5.

1140. Do.—Rev. T. H. A. Houblon † (c. by Miss M. A. Butler). 6. < 4. 7. a rather loud report.

1141. *Wargrave*.—Anon. 3. shortly before 5.45. 4. a vibr. of the windows, f. by an upheaval and subsidence. 6. 5. 7. wind getting up in a sudden squall f. by the sh.

1142. *West Hendred*.—Miss E. G. Hayden. 3. 5.40. 4. the observer woke up suddenly [pr. by first part of sh.], 4 or 5 secs. later the bed began to shudder from E. to W. f. no. 5. roughly 30 secs. 6. < 4. 7. a low rumbling like that of a heavy waggon, coincident with part of the sh. c. p. several secs. d. same int. throughout.

1143. *White Cairn*.—Hon. Mrs. Monckton* (c. by Mr. H. W. Monckton, F.G.S.). 3. 5.34. 4. one series. g. E. to W. 5. 5 to 6 secs. 6. 4.

1144. *Windsor Castle*.—(*The Times*, Dec. 18.) 6. 5?

1145. *Winkfield*.—Anon.† (c. by Mr. M. E. Elliott). 3. ab. 5.30. 6. 5.

1146. *Wokingham*.—Rev. C. W. Penny.* 3. ab. 4 [sic]. 6. < 4. 7. the laboured rumbling of a traction-engine. b. c. d. no.

1147. *Woolstone*.—Mrs. W. T. Butler.* 3. ab. 5.35. 4. the house rocked gently 3 times from W. to E. 5. ab. 2 or 3 secs. 6. 5. 7. as if cows were running on the turf under the window; the end of the so. p. the beg. of the sh. by 1 or 2 secs.

1148. *Yattendon*.—F. E. Waterhouse.† 6. 5.

1149. *Youlbury*.—Prof. W. Boyd Dawkins, F.R.S. 3. ab. 5.30. 4. two shs, with interval of ab. 10 secs, the motion approximately horizontal. 5. ab. 12 secs. 6. < 4. 7. no.

OXFORDSHIRE

1150. *Balscott*.—(*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 6. 5.

1151. *Bampton*.—Rev. J. Jackson. 3. 5.40 A.M. 6. pr. 5. 7. a sudden noise.

1152. *Banbury*.—Anon.* (c. by Rev. C. F. Porter). 3. 5.32. 4. a. yes, 2 or 3 secs. b. 3 vibra, the last the strongest; the movement died away to the S.E. 5. 6 or 7 secs. 6. 5. 7. a heavy vehicle passing, lasting 15 secs. d. yes.

1153. Do.—(*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 3. ab. 5.30. 4. several distinct shakes. 5. ab. 6 or 7 secs. 6. < 4. 7. a rumbling, appearing to die away in the S.E. c. f. ab. 2 or 3 secs.

1154. Do.—(*Bucks Advertiser*, Aylesbury, Dec. 19.) 4. g. the tremor appeared to come from the S.E. 5. ab. 6 secs. 6. pr. 5. 7. acc. by a rumbling noise.

1155. *Bicester*.—Mr. A. Steward. 3. ab. 5.30. 4. only one sh. f. yes. 6. 5? 7. no.

1156. Do.—H. G. Fane. 3. ab. 5.30. 6. 5? 7. no.

1157. *Bloxham*.—(*Banbury Guardian*, Dec. 24.) 3. ab. 5.40. 4. a rolling sensation for a few secs. and then a slight upheaval. 6. 5.

1158. *Brize Norton*.—(c. by Rev. J. W. Wynch.) 6. < 4. 7. a rumbling noise.

1159. *Burford*.—Anon. 3. ab. 5.40. 4. g. W. to E. 5. 5 or 6 secs.

1160. *Caversham*.—Mr. E. B. Hobbs† 3. 5.37. 4. two distinct sha. f. yes. 6. 5. 7. thunder.

1161. *Charlbury*.—(*Banbury Guardian*, Dec. 24.) 3. 5.35. 4. g. N. to S. 7. a rumbling noise like that of a train p. the vibra.

1162. *Chipping Norton*.—Rev. G. A. Littledale† 3. 5.35. 4. (according to another obs. who was awake) trem. mot. for 3 or 4 secs, increasing in int. until the bed seemed to be rocking up and down. 5. perhaps 15 secs. 6. < 5.

1163. Do.—Mr. F. J. Howea. 3. 5.30. 4. 3 distinct sha, separated by ab. 10 secs. 6. 6. 7. a rising gushing wind.

1164. Do.—(*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 3. ab. 5.30. 4. g. N. to S. 5. ab. 10 secs. 6. in some houses crockery was displaced.

1165. Do.—(*Banbury Guardian*, Dec. 24.) 3. ab. 5.35. 6. 6 or 7.

1166. Do.—(*Oxford Chronicle*, Dec. 19.) 6. < 5. 7. a rumbling thud like a crash of falling timber.

1167. *Deddington*.—Rev. T. Boniface. 3. ab. 5.30. 4. a. yes. b. the bed seemed to move up and down several times. d. the same int. throughout. 6. 5. 7. a rushing mighty wind.

1168. Do.—(*Banbury Guardian*, Dec. 24.) 3. ab. 5.30. 4. two vibra. at an interval of a second or two. 6. < 4.

1169. *Epwell*.—(c. by Mr. E. A. Walford, F.G.S.) 3. 5.30. 4. an upheaval, f. by a pause and another upheaval. 6. 5. 7. the passing of a traction-engine.

1170. *Fifield*.—Mr. F. W. P. Matthews* 3. 5.32. 4. 4 or 5 vibra, a swaying motion. 5. 7 or 8 secs. 6. < 5. 7. a few secs. after the sh. a slight noise like wind howling in a chimney.

1171. *Fringford*.—(c. by Rev. C. G. Thompson.) 3. ab. 5.40. 4. f. yes. 6. 5.

1172. *Great Barford*.—Mr. J. Harris* 3. 5.30. 4. one sh. with two max. 6. 5. 7. thunder.

1173. *Great Haseley*.—Rev. W. G. Edwards* 3. 5.35. 4. sh. felt. 7. as if furniture had fallen.

1174. *Great Rollright*.—(c. by Rev. D. M. Gardner.) 4. sh. felt. 7. a rumbling so.

1175. Do.—(*Banbury Guardian*, Dec. 24.) 3. ab. 5.40. 6. pr. 5.

1176. *Henley-on-Thames*.—Sir J. Edwards-Moss, Bart.* 3. bet. 5.15 and 5.30. 5. 1 or 2 secs. 7. the report of a distant cannon; or of a weight falling, not a heavy one, but wrapped up in some soft substance to deaden the so.—“I have here a small collection of orchids of which I suppose a good half, let us say 700-800 plants, stand in pots upon inverted pots. In no case is this a very sure foundation and one often finds some very insecurely placed; any considerable shock would have been absolutely certain to have thrown a few down. I have asked my orchid-man and he says that not one was upset. I think this is quite conclusive of the very trifling nature of the shock here.”

1177. *Iffley*.—Anon.† 3. 5.40. 4. f. yes. 6. 5.

1178. *Kidlington*.—Mrs. A. C. R. Freeborn.† 3. ab. 5.30. 4. f. yes. 6. the bell in the church tower (a small one) was set ringing, bells in the Rectory Farm were set ringing and ornaments thrown down and broken; at a neighbouring farm milkpails set in the open air upon the ground were thrown over. 7. a faint rumbling noise, coinciding with the sh.

1179. Do.—Anon.* (*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 3. 5.30. 4. a backward and forward motion. 5. ab. 15 secs. 6. 5.

1180. *Kingham*.—Mr. E. Lockwood, J.P.† 3. 5.40. 6. pr. < 5.

1181. *Mixbury*.—Anon.* (c. by Rev. R. R. Kirby.) 3. ab. 5.30. 6. < 4. 7. a heavy rumbling so. travelling rapidly which, when it arrived underneath the obs., caused the bed to shake.

1182. *Nettlebed*.—Mr. R. J. Clarke. 3. 5.30. 4. the bed seemed to heave up as if some one underneath were trying to raise it. 5. only a few secs. 6. 5. 7. no, but other observers in the house heard a loud rumbling like a heavy traction-engine coming along.

1183. Do.—(*Reading Mercury*, Dec. 19.) 3. ab. 5.30. 6. 5. 7. the fall of a tree.

1184. *Nuneham Courtenay*.—(c. by Rev. W. H. Castleman.) 6. 5. 7. heavy waggons passing.

1185. *Oxford*.—Mr. S. H. Beake.* 3. bet. 5.35 and 5.40. 4. the bed seemed to give a sudden jerk upwards, f. by a rocking sensation dying away. 5. 4 or 5 secs. 6. 5. 7. no.

1186. Do.—Rev. D. Davies.† 3. 5.34 (time of second sh.). 4. two series, a few secs. bet. them, the second stronger. 5. the second sh. ab. 4 or 5 secs. 6. < 5, possibly 6. 7. no, but another obs. noticed a so. as of a rushing wind.

1187. Do.—Mr. H. H. Joachim.† 3. bet. 5.32 and 5.34. 4. the bed

rocked slowly 3 or 4 times from N. to S. and back. f. no. 5. ab. 3 secs. 6. 5. 7. the obs. thinks he heard a very faint rumbling.

1188. Do.—Mr. R. Cross.* 3. 5.33½. 4. two vibra. or waves, the second stronger. 5. ab. 7 or 8 secs. 6. 5. 7. no.

1189. Do.—Mrs. Sankey.† 3. just before 5.35. 4. only one series. f. no. 5. 2 or 3 secs. 6. < 4. 7. no.

1190. Do.—Mr. G. J. Burch* (*Nature*, vol. 55, 1896, p. 180). 3. ab. 5.40. 4. a movement of the door as if some one was ab. to come in; imm. after a heaving motion of the bed, as if powerful hands had gently raised the mattress slightly and let it drop; then the room rocked 2 or 3 times like a small boat when a steam-launch has passed at some little distance; this was f. by a sudden strong lateral vibr. lasting several secs. g. N.E. to S.W. 6. 5.

1191. Do.—(*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 3. ab. 5.25. 5. ab. 15 secs. 6. 6.

1192. Do.—(*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 4. 3 distinct sha. following closely on one another, the last weakest. 6. 5.

1193. Do.—Anon.† (*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 3. ab. 5.30. 5. several secs. 6. 5.

1194. *Shenington*.—(c. by Rev. A. Blythman.) 3. 5.30. 4. the house shaken twice very much. 7. the two shakes f. by a rumbling as of a heavily-laden waggon going along.

1195. *Shipton-under-Wychwood*.—(*Oxford Chronicle*, Dec. 19.) 3. ab. 5.30. 6. < 4.

1196. *Stonesfield*.—A. Collier. 6. 5.

1197. *Swerford*.—(*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 3. ab. 5.30. 4. two sha. 6. 5? a walking-stick, wh. was standing by the wall, fell down. 7. a loud rumbling noise as though bricks were falling down the chimney.

1198. *Thame*.—Anon.† (c. by Rev. J. I. Cohen). 4. the motion like that made by a heavy traction-engine passing. 6. 6? 7. no.

1199. *Tusmore*.—Lord Howard of Effingham (*Daily Telegraph*, Dec. 18.) 3. 5.40. 4. g. N. to S. 5. barely 2 secs. 6. 4. 7. acc. by a rumbling or throbbing noise.

1200. *Watlington*.—Rev. S. C. Saunders† 3. 5.33. 6. 5. 7. a traction-engine passing (according to other observers).

1201. *Witney*.—Rev. Canon W. F. Norris. 4. two sha. 6. < 4.

1202. Do.—(*Western Mail*, Cardiff, Dec. 18.) 3. 5.35. 6. 6.

1203. *Woodstock*.—Miss A. Jenner (c. by Rev. J. E. G. Farmer). 3. 5.35. 4. one series of vibra. d. yes. e. mid. 5. ab. 10 secs. 6. 5. 7. a noise, like a house falling, before the sh.

1204. *Worton*.—Rev. W. H. Langhorne.* 3. nearly 5.45. 4. a. yes. b. two distinct sha. for 3 or 4 secs, the second part stronger, trem. mot. in the interval bet. 5. ab. 5 secs. 6. 5. 7. a so. as if some heavy body had fallen in the basement, and, 2 or 3 secs. afterwards, a so. as of a door banging.

1205. *Wyfold*.—Anon.† (c. by Mr. W. W. Robertson). 3. ab. 5. 5. < 2 secs. 6. < 4.

WARWICKSHIRE

1206. *Allesley*.—Mrs. Lancaster † (c. by Rev. Dr. W. Bree). 3. 5.35 A.M. 4. an upheaval of the bed as if by some creature underneath. 6. 5. 7. no.

1207. *Aston Cantlow*.—Rev. F. Applewhaite. † 3. 5.35. 4. d. yes. e. mid. 5. ab. 30 secs. 6. < 6. 7. a heavy train or traction-engine. d. yes. e. c. f. no.

1208. *Atherstone*.—Mr. W. Wilson.* 3. 5.33. 4. one vibr., f. by a trem. strain like that experienced when a vessel is struck by a heavy wave. 5. ab. 30 to 35 secs. 6. 5. 7. a so., like the passing of an agricultural cultivator, acc. the sh.

1209. Do.—A. Radford.* 3. 5.30. 4. the bed felt as if raised and dragged from its place by some one at the foot; ab. a sec. afterwards a creaking and moving of the open door. 6. 5.

1210. *Beaudesert*.—Mr. E. Lees. † 3. 5.45. 6. 5.

1211. *Berkswell*.—Mr. F. R. Betts. † 3. 5.29. 4. a vibr. like that produced by a heavy train passing, but much more pronounced and distinct.

1212. *Bidford*.—(*Evesham Journal*, Dec. 19.) 3. 5.30. 4. the vibr. began suddenly, then seemed to lessen a little, and then became somewhat more severe, dying grad. away. 7. a vehicle on a hard road at a distance.

1213. *Binton*.—(c. by Rev. J. H. Dixon.) 3. ab. 5.30. 4. f. yes. 5. some secs. 6. 5.

1214. *Bishops Itchington*.—Rev. J. H. Scowcroft.* 3. 5.35. 4. a. no. b. one prominent vibr. c. no. 5. ab. 3 secs. 7. a heavy vehicle going along the road. b. c. c. c. d. no.

1215. *Bishops Tachbrook*.—Mrs. Hallett. 3. 5.30. 5. 10 secs. 6. pr. 5. 7. after the sh., a noise for 4 or 5 secs. as though clothes had fallen down from a peg and some one were bursting into the room.

1216. *Bourton-on-Dunsmore*.—Anon.* (c. by Rev. E. H. Owen). 3. ab. 5.30. 4. a trem. mot. and vibr. as if some one had hold of the bed and was shaking it: only one sh. 5. more than half a min. 6. 5.

1217. Do.—Anon.* (c. by Rev. E. H. Owen). 3. ab. 5.30. 4. a trem. vibr. as if a traction-engine were passing. 7. a traction-engine passing.

1218. Do.—(c. by Rev. E. H. Owen.) At the school-house no one felt the sh., but the clock there stopped at 5.30 A.M. It was found, on winding up, that it had not gone down.

1219. *Coleshill*.—Mr. T. Smith. 3. ab. 5.35. 4. g. S.W. or nearer W. 6. 5. 7. a so. like the echo of a long distant heavy rock-blasting, f. by sh.

1220. *Coventry*.—Anon. † (*Coventry Herald*, Dec. 18.) 3. ab. 5.40. 4. two distinct shs., the first as though a person had taken hold of the rail of the bed and shaken it; the second more continuous and less violent. 5. 6 to 10 secs. 6. 5. 7. a hollow rumbling noise acc. the sh.

1221. Do.—Mrs. Wilson. † 3. 5.30. 4. distinctly saw and felt the bed move; the bed swayed from side to side. f. no. 6. 5. 7. a noise wh. lasted from 7 to 10 secs.; it resembled the burring so. of heavy machinery, changing into a rumble and grad. going away like distant thunder.

1222. Do.—Mr. A. E. Clarke.† 3. ab. 5.30. 4. several vibra., then a pause, f. by 4 more severe shakes from N.N.W. to S.S.E. 5. ab. 10 secs. 6. 5. 7. no.

1223. Do.—Mr. E. Turrall. 4. the bed appeared to be tilted up slightly from E. towards W., f. imm. by a loud sharp crashing so. on the W. side of the house and then by a slight shaking like that produced by a passing train. 6. 5. 7. b. f. c. f.

1224. Do.—E. M. Masters.† 3. 5.30. 6. 5.

1225. *Easenhall*.—Mr. F. F. Howe.* 3. 5.32.* 4. the house swayed causing the bedstead to move on its castors. 5. several secs. 6. 5. 7. a dull rumble like a train passing over a bridge in the distance. b. p. imm.

1226. *Erdington*.—Mr. S. Pearson.* 3. 5.31. 6. 5. 7. no.

1227. Do.—Mr. H. C. Whincop.* 3. 5.32. 4. a violent rattle of windows, then 6 wave-like motions across the room acc. by a trem. mot. like that produced by a traction-engine or train. 7. a gust of wind. b. p. imm.

1228. Do.—Mr. H. Holloway. 3. 5.33. 4. 3 lateral vibrs. following one another very closely. c. yes. g. N.W. to S.E. 5. ab. 5 or 6 secs. 6. 5. 7. a rumbling so. like the passing of a heavy waggon; it ceased 2 or 3 secs. before the sh. was felt.

1229. *Fillongley*.—Mr. H. A. Adderley.† 3. 5.40. 6. 4. 7. the passing of heavy traffic in the street.

1230. *Hampton-in-Arden*.—Rev. T. J. Morris. 3. 4.35 or 4.40 [sic]. 4. a rocking of the bed. f. no. g. N. to S. 5. a few secs. 6. 5. 7. the sh. acc. by a rumbling so. like distant thunder, continuous and of fairly equal int. until it died away with the oscillating movement.

1231. *Hampton Lucy*.—Rev. O. Mordaunt.† 3. 5.40. 5. ab. 3 or 4 secs. 6. pr. 5. 7. a gale of wind; pr. loudest during the vibra.

1232. *Henley-in-Arden*.—Mr. C. E. Welsh.† 3. ab. 5.34. 4. the bed swayed. f. yes. 5. 2 secs. 6. 5. 7. a stack of coal falling.

1233. Do.—(c. by Rev. G. E. Bell.) 6. < 5.

1234. *Ilmington*.—Mr. J. H. Warner.† 3. ab. 5.40. 4. pr. two series; a rocking like that felt on board ship in a slightly rough sea. 5. 10 or 15 secs. 6. pr. 7. 7. the so. compared by others to the roaring of a very large fire and to the noise made by a heap of masonry falling. b. c. c. c.

1235. *Kenilworth*.—(*Banbury Guardian*, Dec. 24.) 6. 5.

1236. *Kineton*.—Anon. 6. 5.

1237. *Kingsbury*.—Rev. R. L. Onslow.* 3. 5.30. 6. 5. 7. no.

1238. *Leamington*.—Mr. J. C. Whitehouse.* 3. ab. 5.30. 4. a rocking of the bed as if a very strong man were pulling it sideways, at the same time also a kind of heaving and sinking like that felt in a large ship at anchor with a gentle swell. 5. ab. 15 secs. 6. 5. 7. imm., or ab. the time when, the vibra. ceased, a deep rumbling so. heard like that produced by a furniture-van driven at a trot; this seemed to pass away toward the S.W. and to last another 15 secs.

1239. Do.—Major W. H. Barker.* 3. 5.35. 4. as if some one had given 4 distinct pulls at the foot of the bed, grad. diminishing in int., nearly a second interval between each pull. 6. the poker slid off the "dog"

and fell on the fender; a china ornament on a small wall-bracket was moved from N. to S. 7. a heavy rumbling noise, such as would be caused by a heavy soft body falling from a height on a wooden floor; an interval of ab. 2 secs. separated the end of the noise and the beg. of the sh.

1240. Do.—Mr. S. S. Stanley.* 4. f. yes. 5. ab. 6 secs. 6. 5.

1241. Do.—Mr. A. Outram. 3. ab. 5.30. 4. two distinct sha., separated by ab. 3 or 4 secs., the first stronger, the second a distinct tremble. 5. ab. 7 or 8 secs.

1242. Do.—Mr. E. Field.* 3. ab. 5.35. 4. only one sh., with trem. mot. 5. 2 to 3 secs. 7. as if a chimney-stack had fallen through the roof. b. c. c. c. or f. slightly.

1243. Do.—Mr. W. Jenkins.* 3. 5.30. 4. 4 or 5 horizontal vibrs. 5. 20 secs. 6. 5. 7. a large heap of coal falling; f. the sh.

1244. Do.—Miss Grey-Edwards.† 3. 5.33. 4. g. N.W. to S.E. 5. quite 6 secs. 6. < 5. 7. no.

1245. Do.—C. M. Corbet.* 3. after 5.30. 4. the bed rocked from side to side (i.e. N. and S.). 5. a few secs. 6. < 5. 7. no.

1246. Do.—A. Loveday. 3. ab. 5.30. 4. g. N. and S. 6. < 5.

1247. Do.—Mr. S. Tebbutt.† 3. 5.33. 4. two sha. 5. 2 to 3 secs. 7. no.

1248. Do.—E. Fullerton.† 3. 5.30. 4. the bed heaved gently up and down ab. 5 or 6 times. 6. 5.

1249. Do.—Mr. W. Dawkes.† 3. 5.30. 4. only one sh. 5. ab. 15 secs.

1250. Do.—Mr. J. H. Murray-Browne.* 4. only one sh. 5. momentary. 7. no.

1251. Do.—Mr. S. Widdowson. 3. ab. 5.30. 4. one continued tremor. 7. a loud report, like the firing of a heavy gun, p. the shaking.

1252. *Little Kington*.—Mr. H. Allibone.* 3. bet. 5.25 and 5.30. 6. pr. 5. 7. no.

1253. *Long Compton*.—(*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 3. ab. 5. 6. 5. 7. a rumbling noise.

1254. *Maxstoke*.—(c. by Mr. T. Smith.) 4. sh. felt. 7. so. heard.

1255. *Middleton*.—(*Daily Telegraph*, Dec. 19.) 3. 5.45. 4. the sh. began with a marked vibr. and then the house heaved and swayed. 6. 5. 7. the sh. f. by a low rumbling noise as of heavy traction-machinery approaching in the distance.

1256. *Napton*.—Mrs. Irwin. 3. ab. 5.35. 4. a rumbling noise, then the room moved as if going down the hill, a distinct rest for a sec. and then a much louder noise, and the room seemed lifted up more severely than at first. 6. pr. 6. 7. a noise, like a heavy cart going over a hollow road, coming from the N.

1257. *Newton Regis*.—Anon.* (c. by Mr. C. W. A. Fritche, jun.) 3. 5.30. 4. two [series of] vibra. 5. ab. a min. 6. pr. 6.

1258. *Nuneaton*.—Mr. W. T. Bates. 3. 5.33. 4. the movement as if a heavy person were standing in the centre of a weak floor and swaying it up and down; a triple movement first, and then after a slight interval two more weaker movements. 5. pr. > 10 secs. 6. 5. 7. a heavy vehicle passing in the road.

1259. Do.—Anon.* (c. by Mr. W. T. Bates). 7. the rumbling, as of a train coming, heard for some time before the sh. was felt.

1260. *Offchurch*.—Lady Alexandra Finch. 3. 5.30. 4. only one sh. 5. ab. 6 to 7 secs. 7. no.

1261. *Olton*.—Mr. S. E. Cox.† 3. ab. 5.34. 4. the bed was lifted and rocked; there were 3 separate waves, each f. by violent tremors. g. S.W. to N.E. 5. 6 or 7 secs. 6. pr. 6; the ceilings in every room, from ground floor to roof, badly cracked. 7. a loud report as from an explosion, distinctly coming from the ground, and simultaneous with the beg. of the sh.

1262. *Over Whitacre*.—Rev. J. G. Lane.† 3. 5.30. 6. < 5. 7. no.

1263. *Ozhill*.—(c. by Rev. J. C. Hill.) 3. 5.30. 4. two distinct vibra., as if the bed were lifted by some one underneath. 6. < 5.

1264. *Penna*.—Mr. M. Brooks. 3. 5.35. 4. the bed oscillated from S.W. to N.E. 5. ab. 30 secs. 6. 5. 7. a suppressed dull sound, such as results from a very heavy distant fall. b. p. imm.

1265. *Princethorpe*.—(c. by Rev. E. H. Owen.) 6. 5.

1266. *Rovington*.—Anon.† (c. by Rev. P. B. Brodie, F.G.S.). 3. ab. 5.30 or 5.35. 6. 5?—Mr. Brodie adds that he cannot ascertain that any one in the parish heard any so.

1267. Do.—Mr. J. Booth.† 4. a distinct wave-like motion. 6. < 4.

1268. *Rugby*.—M. R. Hunt. 3. ab. 5.30. 4. a violent shaking of the bed wh. ceased very grad. 5. ab. 60 secs. 6. 5.

1269. Do.—Mr. E. H. Speight.* 3. ab. 5.35. 5. ab. 2 or 3 secs. 6. pr. 5. 7. a rumbling so. coming from ab. N.

1270. Do.—Miss K. P. Shaw.† 3. ab. 5.33. 5. > 2 secs. 6. < 4.

1271. Do.—Anon.* (*Midland Times*, Rugby, Dec. 19). 3. ab. 5.30. 6. < 4. 7. a load of bricks being tipped down close to obs.

1272. Do.—(*Birmingham Daily Gazette*, Dec. 18.) 3. ab. 5.30. 4. a slight tremor of short duration, f. after a brief interval by a more perceptible vibr. wh. lasted several secs.

1273. *Sheldon*.—Mrs. Robinson.† 3. soon after 5.30. 5. ab. 3 or 4 secs. 6. < 4. 7. no.

1274. *Shirley*.—Mr. G. L. Watson. 3. ab. 5.33. 4. onesh. g. N.N.W. to S.S.E. 5. ab. 3 secs. 6. 5. 7. a rumbling and rushing so. acc. the sh.

1275. *Solihull*.—Rev. T. B. H. Brooks.† 3. 5.32. 5. ab. 30 secs. 6. < 5; the doors of a very massive antique wardrobe and of a corner cupboard were thrown open.

1276. *Southam*.—Mr. E. J. Dalton.† 3. 5.35. 4. the brass handles of a chest of drawers rattled for ab. 10 to 12 secs, at the end of wh. the bed was suddenly moved as if by some heavy body thrown against the legs. 6. 5.

1277. *Stivichall Hill*.—Alderman W. Andrews, F.G.S. 3. 5.35½. 4. the building app. sank ¼ of an inch and instantly rebounded to its former level. 5. > ¼ sec. 6. 5. 7. a loud rumbling noise, like something rolling on the roof of the house. b. p. ab. 4 secs. c. c.

1278. *Stratford-on-Avon*.—Mr. S. E. Meredith. 3. ab. 5.25. 4. a. yes, ab. 2 secs. b. one series, ab. 5 secs. d. yes. e. mid. f. no. 6. < 5. 7. no.

1279. Do.—Anon.† 3. bet. 5.30 and 5.45. 4. the bed shook as if some one were under it, only one sh. 6. 5. 7. the sh. f. by a rumbling as if heavy carts were passing.

1280. Do.—Mr. W. Fox. 3. 5.30. 4. b. one vibr. c. yes. f. yes. 6. 5. 7. no.

1281. *Stretton-on-Dunsmore*.—Mrs. J. Richardson. 3. ab. 5. 4. the bed was shaken quite forcibly and then it appeared as if some one were underneath the bed raising it up. 6. 5. 7. no.

1282. *Sutton Coldfield*.—F. M. Todd.† 3. 5.40. 4. the bed shook violently from side to side, ending with an upheaval on the E. side. 5. several secs. 6. 5. 7. a loud report like that of a boiler-explosion.

1283. Do.—Mr. R. C. Bradley. 3. just after 5.32. 4. the bed rocked from side to side. e. end. 5. ab. 3 secs. 6. 5. 7. no, but other observers say it resembled a distant luggage-train.

1284. *Temple Balsall*.—Mrs. Stewart.† 3. ab. 5.30. 4. a general swaying movement like that of an express train going at full speed. 6. 5. 7. the rumbling of very heavily-laden carts all round the house.

1285. *Ullenhall*.—Mr. W. Tyler* (c. by Rev. M. R. West). 3. 5.30, 4. 3 series, ab. 2 secs. bet. each, the first strongest. e. beg. f. yes. 5. 7 or 8 secs. 6. 5. 7. no.

1286. Do.—Anon.* (c. by Rev. M. R. West). 3. 5.35. 4. 3 prin. vibra. [or series]. 5. < 10 secs. 6. 5.

1287. Do.—Anon.* (c. by Rev. M. R. West). 3. 5.30. 4. one series. 5. 3 or 4 secs. 6. pr. 5.

1288. *Walmley*.—Anon.† (c. by Mr. F. W. Thomas). 4. 3 vibra, the motion first vert. then horizontal. 6. < 4.

1289. *Warwick*.—The Right Hon. the Earl of Warwick.* 3. 5.33.* 4. the bed was suddenly lifted up, as if a large dog were underneath it; this was f. by a low rumbling acc. for ab. 3 or 4 secs. by very rapid, but not violent, vibra.; within $\frac{1}{4}$ min. after the ceasing of the vibra, there was a recurrence of the same lifting of the bed, noise and vibra, lasting a little longer than the first time. 6. 5. 7. a low rumbling like a distant train in a tunnel.

1290. Do.—(*Birmingham Daily Post*, Dec. 18.) 6. no damage was done in the town except that a few bricks were shaken off a chimney in Swan Street.

1291. *Wellesbourne*.—(*Banbury Guardian*, Dec. 24.) 3. 5.33. 5. some secs.

1292. *Willoughby*.—Rev. C. H. Deane. 3. 5.35. 6. 5. 7. a railway-train passing near the house. b. f. c. f. d. yes. e. f.

1293. *Wootton Waven*.—Rev. F. T. Bramston.* 3. 5.35. 4. at first like the motion caused by a heavy thrashing-machine passing, growing grad. stronger until the bed rocked to and fro, and passing away as it began. 6. < 5. 7. one obs. compared the so. to that made by a corn-mill.

1294. *Wylde Green*.—A. S. Wright.* 3. 5.34. 4. the whole room swayed; the head of the bed appeared to lurch down just as a small boat does on a rather rough sea; only one sh. 5. ab. 5 or 6 secs. 6. 5. 7. no, but another obs. was wakened by a low rumbling noise, like that of a traction-engine passing, f. by the sh.

BIRMINGHAM AND NEIGHBOURHOOD

(Including Aston, Handsworth, Harborne and Smethwick in Staffordshire ; Salltley in Warwickshire ; and King's Heath, Moseley, Selly Hill, Selly Oak, and Spring Hill in Worcestershire.)

1295. *Birmingham*.—(*Times*, Dec. 18 ; *Birmingham Daily Post*, Dec. 18, 1896, and Feb. 8, 1897, etc.) A chimney fell in Spencer Street ; at Balsall Heath a stack of timber was thrown down ; in Steelhouse Lane a jug was upset and broken ; at the Art Gallery a good deal of damage was done through the falling of ornaments and clocks. In a house at the west end of Hagley Road a pane of plate-glass in the upper half of a window facing south was broken ; the two halves of the window were screwed together near the middle, and the crack starts upwards from the screw and then curves round so as to meet the west side near the top.

Shortly after the earthquake, it was found that some damage had occurred to the beautiful spire of St. Augustine's Church, Edgbaston, and it was at first supposed that this was an effect of the shock. The spire is 185 feet in height, and about 25 or 30 feet from the top fragments of stone fell on Dec. 24 or 25, about a fortnight later, and again on Feb. 6. There had evidently, however, been a previous crack, for the inner surfaces of the fragments were darkened by smoke and the action of the weather. It seems possible, as has been suggested, that the cracks were made by lightning, and that the fragments were loosened by the earthquake, and afterwards thrown down during the rough weather which succeeded it.

1296. Do.—Mr. J. Kings,† Council House. 3. the library clock stopped at 5.32. 4. two shs, with an interval of ab. 3 secs. bet. them ; the first the stronger and lasting ab. 4 secs., the second ab. 5 secs. g. N.E. to S.W. 5. ab. 12 secs. 6. 6. 7. a rumbling so. like the roll of thunder.

1297. Do.—A. Frost,* 7 Algernon Road. 3. shortly after 5.30. 4. sh. felt. 7. a rumbling noise as of the approach of a train in the distance, f. by a so. as of papers being loosened from the walls and falling forwards in places.

1298. Do.—Mr. W. Jones,† 162 Ashted Row. 3. 5.34. 6. 6 ; having a light in the room, the obs. could see a picture swing from the wall ab. an inch and fall back again into its place ; the movement was repeated ab. 8 or 10 times at the rate of ab. 3 or 4 per sec.

1299. Do.—Mr. T. Avery,* 195 Bloomsbury Street. 3. bet. 5.31 and 5.32. 4. only one sh. 5. 3 to 5 secs. 6. < 4. 7. no.

1300. Do.—Mr. W. T. Watts, 107 Bristol Road. 3. 5.34. 4. g. N.W. to S.E. 5. < 2 secs. 6. 5. 7. a dull so., as of a very distant explosion ; no perceptible interval bet. the so. and sh.

1301. Do.—Mr. T. F. Proctor,† 6 Byron Road. 3. 5.33.* 4. the head of the bed rose and fell slowly and gently twice, exactly like the slow pitch of a steamer on a quiet sea. 5. ab. 12 secs. 6. 5. 7. a dull heavy thud like the so. caused by a large fall of snow from the roof. b. p. imm.

1302. Do.—Miss A. E. Clark, M.D.,† 4 Calthorpe Road (a. by Mr. J. E.

Clark). 4. the bed swayed from side to side, and again, but less, after a pause of one or two secs. g. E. and W. 6. 5.

1303. Do.—Mr. A. Wyer, 315 Camden Street. 3. 5.35. 4. a rhythmic rise and fall of the floor of the room, ab. 3 vibrs. to the sec.; a continuous sh., but it decreased and afterwards increased before it ceased. 5. ab. 7 secs. 6. 5. 7. no.

1304. Do.—Mr. A. Gibbs, 95 Cato Street. 3. 5.35. 5. 30 secs. 6. 5. 7. a slight rumbling so. ab. 2 secs. after the sh.

1305. Do.—Prof. F. J. Allen,† 21 Chad Road. 3. ab. 5.36. 4. the bed oscillated rapidly from E. to W. 5. > 5 secs. 6. 5. 7. no.

1306. Do.—Mr. H. J. G. Ball,* 16 Charlotte Road. 3. 5.28. 4. a heavy tremble or grind; the first impulse was violent and f. by a kind of throb. 5. 2 secs. 6. < 4.

1307. Do.—Miss Adams,† 16 Charlotte Road (c. by Mr. H. J. G. Ball). 3. 5.30 or 5.31. 4. the bed violently shaken from N.W. to S.E. 6. 5.

1308. Do.—Mr. F. Howard Collins,† Churchfield, Church Road, Edgbaston. 3. 5.26. 4. only one sh. g. N.N.W. and S.S.E. 6. 5. 7. no.

1309. Do.—M. Byfield, Hawthorn Cottage, near Coventry Road. 3. not later than 5.30. 4. b. bed slightly raised and jerked violently backwards and forwards, > 2 or 3 secs. c. yes. g. E. and W. 6. 5. 7. a train coming along the line; the beg. of the so. c. with that of the trem. mot., it lasted ab. 10 or 12 secs., and ended 2 or 3 secs. after the trem. mot.

1310. Do.—Mr. R. Wilson,† 39 Dean Street. 3. 5.32. 4. a quivering of the building as if an exceptionally heavy, but noiseless, steam-roller were passing, f. by a peculiar vibr. of the windows as if hailstones were pattering on the panes. 5. 5 or 6 secs.

1311. Do.—Mr. F. W. Jervis,† 19 Drayton Road, Edgbaston. 3. ab. 5.40. 4. two series, the first stronger. 6. 5; the water in a basin danced about. 7. no so. with the first series; with the second, a rumbling so. like a heavy gust of wind. b. f. imm. c. f. d. yes.

1312. Do.—Prof. C. Lapworth, F.R.S., 13 Duchess Road, Edgbaston (*Birmingham Daily Post*, Dec. 18). 3. ab. 5.35. 7. (according to another obs.) a premonitory noise like that of a heavily-laden cart passing over a rough street.

1313. Do.—Mr. D. Wood,* Dudley Road, Winson Green. 3. 5.33.* 6. 4. 7. a heavy load of coal or bricks shot out of a cart; the so. lasted 2 or 3 secs., became grad. louder and then died away.

1314. Do.—Mr. T. A. England,* Duke Street Police-Station. 3. 5.35. 4. a shaking of the building causing the obs. (who was standing) to sway backwards and forwards. 5. ab. 5 secs. 6. 5. 7. a train passing under a bridge. b. p. ab. 1 sec. c. f. ab. 1 sec.

1315. Do.—Mrs. Davis,† 45 Francis Road, Edgbaston. 3. 5.30. 6. 6?

1316. Do.—Mr. E. Airey,* 13 Gillott Road. 3. 5.33. 4. g. N.E. to S.W. 6. 5. 7. the so. of a hissing wind and a dull rumbling so.

1317. Do.—Dr. C. Davison,† 373 Gillott Road. 3. 5.32½,* but nearer 5.33 than 5.32. 4. 8 well-marked vibrs. in two sets of 4 each, the interval bet. the 4th and 5th ab. half as long again as bet. the others; the vibrs. of approximately equal int. and in the nature of pushes, the return movement

being almost imperceptible. f. no. g. ab. N.W. to S.E. 5. 3 secs.* 6. 5. 7. no.

1318. Do.—Mr. F. Houghton,* 119 Gough Road. 3. bet. 5.33 and 5.34. 4. g. S.W. to N.E. 6. 5. 7. no.

1319. Do.—Mr. F. O. Lane,* 46 Grantham Road, Sparkbrook. 3. 5.33. 4. 2 vibra, only one series. 5. 4 or 5 secs. 6. 5. 7. the rising of the wind.

1320. Do.—Miss Joyce, Greenfield Crescent (*Birmingham Daily Post*, Dec. 18). 6. 5. 7. a heavily-loaded dray. b. p.

1321. Do.—Mr. W. Hopkins,† 127 Hagley Road. 3. 5.25. 4. the whole room shook and trembled, imm. after wh. the obs. seemed to be thrown 4 times towards the foot of the bed and back, then a second's interval and a thud on settling. g. E. to W. 6. 5. 7. awakened by a noise like thunder.

1322. Do.—Mr. J. Gray, 290 Hagley Road. 3. 5.33.* 4. an undulating or wavy motion of the bed from N. to S. 5. ab. 8 to 10 secs. 6. 6?

1323. Do.—“H. J.”* (*Daily Argus*, Birmingham, Dec. 17). 3. 5.40. 4. a sudden vibr. f. by a violent jerk. g. W. to E. 6. 5. 7. a traction-engine passing. c. p.

1324. Do.—Mr. W. J. Riley,† 38 Handsworth Wood Road. 3. 5.33.* 4. ab. 30 vibra, in series of ab. 5 each, with very slight intervals. 5. ab. 15 or 20 secs. 6. 4. 7. no.

1325. Do.—F. E. Chance,* Chad Hill, Harborne Road. 3. ab. 5.30. 4. two, one rather severe, the second scarcely perceptible. 6. 5.

1326. Do.—Mrs. Martindale, 71 Homer Street, Balsall Heath. 3. 5.35. 4. 2 vibra, f. by trem. mot. 5. 6 secs. 6. 5. 7. heavy vehicle rattling past. c. c.

1327. Do.—Mr. H. E. Horton, 394 Ladypool Road, Sparkbrook. 3. ab. 5.30. 4. 5 or 6 vibra, p. by trem. mot. such as would be produced by the passing of a railway-train. 5. < 5 secs. 6. 6. 7. like that of the loose windows of a train when passing points on rails. b. p. ab. 5 secs.

1328. Do.—Obs.* (c. by Mr. J. W. Carn), 27 Ladywood Road. 3. ab. 5.30. 4. several vibra. g. N. to S. 6. 5.

1329. Do.—Mr. G. Brewerton,† 5 Montague Road. 3. 5.33. 4. two distinct series, lasting not more than 3 secs. each, interval not more than 2 secs. 5. > 8 secs. 6. pr. 5. 7. no.

1330. Do.—Rev. M. Rudkin,† Monument Road (*Birmingham Daily Post*, Dec. 18). 3. 5.30. 4. g. S.E. to N.W. 6. pr. 6.

1331. Do.—Mr. W. G. McMillan, Monument Road (*Birmingham Daily Post*, Dec. 18). 4. two distinct sha. g. N.W. to S.E., or slightly more inclined to the N. 6. < 4. 7. so. heard.

1332. Do.—Mr. A. R. Taylor, 78 Moseley Road. 3. 5.34. 4. 3 vibra, as if some one jerked the bed sideways. 5. 2 or 3 secs. 6. 5. 7. no.

1333. Do.—Mr. O. W. Evans, 318 Moseley Road. 4. two vibra. 6. pr. 5. 7. no.

1334. Do.—Anon., Mountford Street, Sparkhill. 3. 5.28. 4. 4 short vibra, a pause, and then one more. 5. ab. 10 secs. 6. 5. 7. no.

1335. Do.—Mr. G. Wilkinson,* 7 Mozart Place. 3. 5.30. 4. f. a distinct upheaval of the floor. g. W. to E. 5. a few secs. 6. < 5. 7.

a loud report, like that of a boiler-explosion, imm. f. by a noise as of tons of debris hurled against the wall of the house.

1336. Do.—E. B. Morgan,* 112 Nechells Park Road. 3. 5.33. 6. pr. 5. 7. a loud rumbling noise. b. p. imm.

1337. Do.—Mr. T. Baker,† 325 Nechells Park Road. 3. 5.35. 4. one distinct wave, the bed seemed to be lifted ab. 6 inches. g. N.W. to S.E. 7. some time before the sh. a noise as of a number of trams passing; the eq. ended with a noise like an express train under an arch.

1338. Do.—Anon., New Spring Street. 3. ab. 5.28. 4. the motion like that of a cradle rocked violently three times. 5. ab. 3 or 4 secs. 6. 5. 7. distant thunder, grad. dying away.

1339. Do.—Mr. C. C. White,† Oakfield Road, Cannon Hill (*Birmingham Daily Post*, Dec. 18). 4. a rocking and shaking, terminated by a violent upheaval; for ab. 2 mins. [*sic*] all was still, and then came a much slighter shock. 6. 6. 7. the first sh. acc. by a deep rumbling like that of an express train passing; the second was not acc. by any so.

1340. Do.—Mr. E. Cook,* 242 Pershore Road. 3. 5.30 or 5.31. 5. ab. 30 secs. 7. a sudden loud noise or concussion, f. by a distinct shaking of the house.

1341. Do.—Mr. W. P. Marshall,† Richmond Hill Road. 3. ab. 5.35. 4. an upheaval of the bed, f. by a side shake. 6. 5. 7. a heavy cart passing.

1342. Do.—Miss E. Ryland, 15 Rotton Park Road. 3. ab. 5.35. 4. two distinct sha., each consisting of 3 vibra., an interval of ab. a sec. between the two sha. g. E. to W. 5. ab. 5 secs. 6. 5. 7. so. heard. b. p. c. p.

1343. Do.—Mrs A. Harris,† 30 Rotton Park Road. 3. 5.35. 6. 5. 7. a so. as of a heavy footstep or bang in the room above.

1344. Do.—Mr. W. Taylor,† Rotton Park Road. 3. 5.35. 4. continuous vibra., ending suddenly. 5. ab. 3 or 4 secs. 6. < 4.

1345. Do.—Rev. J. T. Butlin, St. Clement's, Nechells (*Birmingham Daily Post*, Dec. 18). 3. 5.35. 4. a violent oscillation of the bed, beginning with wider movements, and after a few secs. passing away with a trembling. g. N.E. to S.W. 6. 5.

1346. Do.—"H. J. O."† 4 St. George's Crescent, Hockley (*Daily Argus*, Birmingham, Dec. 17). 4. there appeared to be two distinct series, the first being the more powerful and prolonged. 6. pr. 5.

1347. Do.—Mr. H. M. Pumfrey,* 94 Saddler Street, Sparkhill. 3. 5.35. 4. g. N.W. and S.E. 5. ab. 4 or 5 secs. 6. 5. 7. a traction-engine at a distance; the so. p. the sh. by ab. 10 secs. and died away as the sh. began.

1348. Do.—Mr. H. McGregor,† 14 School Road, Sparkhill. 4. the bed rocked violently with a uniform and not unpleasant motion, decreasing in int. with each oscillation. 6. 5. 7. a rushing wind.

1349. Do.—Mr. H. T. Stubbs,* G.W.R. Telegraph Office, Snow Hill Station. 3. 5.33.* 4. two vibra. g. N.W. to S.E. 5. ab. 3 secs. 6. 5.

1350. Do.—Mr. D. H. Hopkins,* Victoria Hotel, Stafford Street. 3. ab. 5.30. 4. a sudden vibr. for ab. $1\frac{1}{2}$ secs., then two reports and almost instantly the house began to rock to and fro. 5. > 4 secs. 6. 5. 7. two reports as though large cannons were being fired at a distance.

1351. Do.—P. Fenton,† 96 Stanhope Street. 6. 5. 7. a chimney on fire.

1352. Do.—Mr. H. M. Briggs, jun., 22 Stratford Place, Camp Hill. 3. 5.33 to 5.34. 4. an upheaval, f. by a trem. mot.; then, after a second, another trem. mot. f. by two slight upheavals. g. E. and W. 5. ab. 15 to 20 secs. 6. 5. 7. a goods-train passing. b. p. ab. 5 secs, the end of the so. c. with the beg. of the sh.

1353. Do.—J. Coldwell,† 102 Vincent Street, Balsall Heath. 3. 5.30. 4. the bed rocked 5 or 6 times. 6. 5. 7. after the sh., a noise as of a laden cart in the distance.

1354. Do.—Mrs. J. Holt,† 88 Wellington Road, Edgbaston. 3. ab. 5.35. 4. the bed moved three times, twice one way and once another. 6. 5.

1355. Do.—Mr. E. A. Fry,* 38 Westfield Road (*Birmingham Daily Post*, Dec. 18). 3. 5.35. 4. premonitory vibra., wh. caused the door to rattle, f. by a sharp shake. g. S.W. to N.E.

1356. Do.—Mr. W. H. Johnson,† 65 Wheellys Road. 3. 5.32. 6. < 4. 7. a so., like a mixture of a train rumbling and distant thunder, acc. the sh.

1357. Do.—A. Jones,† 45 Whittall Street. 3. 5.42. 4. g. N.E. to S.W. 5. ab. 10 secs. 6. 6. 7. the sh. acc. by a noise as of rushing wind, though the air was perfectly still.

1358. Do.—Mr. R. Welsh,† Willow Road, Balsall Heath. 3. 5.33. 4. g. W. to E. 5. 2 secs. 6. 5. 7. distant thunder.

1359. Do.—Mr. S. R. Davis,* 91 Wilton Road, Sparkhill. 3. 5.35. 5. 3 secs. 6. 4. 7. no.

1360. Do.—M. Newman,* 5 Wright Street, Smallheath. 3. 5.30. 4. 3 or 4 undulatory movements of the bed. 6. 5. 7. a dull rumbling of thunder. b. p. imm.

1361. *Aston*.—Mr. C. F. Cornick, 68 Ettington Road. An old "grand-father clock" stopped at 5.38.

1362. Do.—Mr. J. H. Hart,† 2 Lozells Grove, Chain Walk. 3. 5.26. 4. two series, with an interval of 2 or 3 secs. 5. 10 to 12 secs. 6. 5.

1363. *Handsworth*.—Mr. E. Clack,† 1 The Avenue, Alfred Street. 3. ab. 5.30. 4. the bed seemed to be lifted up several inches. 5. a few secs. 6. 5.

1364. Do.—Mr. W. S. Hollings,* 249 Birchfield Road. 3. 5.33½. 4. 4 waves in rapid succession. g. S.E. to N.W. 5. 3 secs. 6. 5. 7. no.

1365. Do.—Mr. W. J. Harrison,† 52 Claremont Road. 3. bet. 5.30 and 5.35. 4. g. W.S.W. to E.N.E., but the obs. thought he detected both a rotatory and an upward component in the motion. 5. pr. not 2 secs. 6. 5. 7. a dull low noise, something like the boom of a distant cannon, f. by a violent shaking.

1366. Do.—Mr. J. T. James, The Oaks, Grove Lane. 3. ab. 5.30. 4. bed apparently lifted in a slightly forward direction ab. 2 ins. towards the S.E. 5. ab. 3 or 4 secs. 6. 5. 7. the lowering of a Venetian blind.

1367. Do.—Mr. T. Fletcher,† Hall Road. 3. just before 5.30. 4. the bed shaken as if it had been set on spiral springs. 5. a few secs. 7. a loud rumbling noise.

1368. Do.—Mr. E. J. Shaw,* 16 Hamstead Road. 3. 5.34½. 4. 3 or 4 movements, the first undulatory; of the others, two were well-marked and

of a vibratory tremulous nature, with some secs. interval. g. S. to N. 6. 5.
7. a train passing over arches. b. p. imm.

1369. Do.—J. R. Wilton,† 118 Hamstead Road. 3. 5.32. 6. 4. 7.
awakened by a thud, as if a heavy weight had fallen.

1370. Do.—E. M. Canning,† 60 Hunter's Road. 3. ab. 5.33. 4. the
house shaken as if a heavy goods-train had passed very near. g. N. to S.
5. ab. 6 or 8 secs. 6. 5. 7. no.

1371. Do.—Mr. W. J. Harrison, jun., 122 Linwood Road. 3. 5.35.
4. a lateral movement from E.S.E. to W.N.W., with an uplift to W.N.W.
5. 2 secs. 6. 5. 7. no.

1372. Do.—N. Mills, Montague Road. 3. 5.35. 5. ab. 7 to 10 secs.
6. 5? 7. after the trembling ceased, a very distant so. as of thunder.

1373. Do.—Mr. R. Mayo, Robert Road. 3. 5.30. 4. both saw and
felt the bed-post shake. 5. a few secs. 6. 5. 7. a prolonged clap.

1374. Do.—Mr. C. Lamsdale, St. Peter's Road. 3. ab. 5.30. 4. several
violent vibra. g. N. to S. 5. 6 or 8 secs. 6. 5. 7. as if a steam-roller
had hurriedly passed the house; it seemed to accompany the vibr. and die
away with it.

1375. Do.—Mr. R. J. Chaundy, 204 Soho Road. 3. 5.30 to 5.35. 5.
ab. 5 or 6 secs. 6. a clock stopped. 7. heavy thunder, but very sharp.
b. p. ab. 3 secs. c. f. ab. 3 secs.

1376. Do.—Mrs. Braham,† 18 South Road. 3. 5.35. 4. 3 or 4 vibra.
5. ab. 6 secs. 6. 5. 7. no.

1377. Do.—Anon.† Stamford Road. 3. 5.30 to 5.35. 4. ab. 15 to
18 vibra. 5. 4 or 5 secs. 6. 5. 7. no.

1378. *Harborne*.—Mr. W. T. Sibley,† The Beeches, Metchley Lane. 3.
5.35. 4. g. N. and S. 5. ab. 5 secs. 7. no.

1379. Do.—Miss J. E. Pemberton,* 44 Park Road. 3. 5.30 or 5.35.
7. a sudden and violent rush of wind.

1380. Do.—Rev. D. E. Shorto,† 1 Park Hill Road. 3. 5.30 or soon after.
6. 5. 7. no.

1381. Do.—Mr. J. F. Green,† St. Mary's Road. 3. 5.32½ to 5.32¾.*
5. ab. 10 or 12 secs. 6. 4.

1382. Do.—Mr. C. E. Layton, 23 Victoria Road. 3. ab. 5.30. 7. a
sharp tearing so., like that produced by a distant explosion of gunpowder.

1383. *King's Heath*.—E. Speller, Oak Villa, Alcester Road. 3. 5.33.
4. one severe and two minor wave-motions, f. by trem. vibra. 5. 8 to 10
secs. 6. 5. 7. sh. f. by a slight rustling so. for ab. 2 secs.

1384. Do.—Mr. F. Moore,† The Hollies, Alcester Road. 3. 5.35. 4.
the bed swayed to and fro from N. to S. 5. ab. 10 to 12 secs. 6. pr. 5.
7. awakened by a dull bumping so. like that of a heavy barrel being moved
down the cellar steps.

1385. Do.—Rev. E. W. Badger,† Cambridge Road. 3. 5.30. 4. ab. 5
steady swinging vibra. g. W.N.W. and E.S.E. 5. 3 to 4 secs. 6. 5. 7.
a steady rushing so. in the air, distant and distinct, heard ab. the end of the
sh. and continuing some little time after the sh.

1386. Do.—Mr. W. F. Ball,† Cambridge Road. 3. 5.36. 4. an up-
heaval of the bed, without any trem. mot. 6. 5. 7. no.

1387. *Moseley*.—L. H. Mander,† 30 Alcester Road. 3. ab. 5.32.

4. three distinct upward movements, f. by a trem. mot.; the motion seemed to subside and recommence. 5. ab. 5 secs. 6. 5. 7. the sh. p. by a rumbling noise as of numbers of very heavy weights falling.

1388. Do.—Mr. E. A. Lees,† Forest Road. 3. 5.33. 5. 3 to 5 secs. 6. 5. 7. a rumbling noise.

1389. Do.—Mr. J. Smith,† Redclyffe, Greenhill Road. 6. 6. 7. a cart with loose stones passing.

1390. Do.—Rev. J. H. Smith,† Avonmore, Greenhill Road. 3. 5.35. 5. ab. 10 secs. 6. 5. 7. so. heard. d. yes.

1391. Do.—Mr. L. Holland,† Greenhill Road. 3. ab. 5.30. 6. 5. 7. no.

1392. Do.—Miss L. M. Pumphrey,† Castlewood, Park Road. 3. ab. 5.30. 4. as if the bed were shaken rather strongly 4 or 5 times in quick succession. 6. 5. 7. a so. like something rushing down the chimney.

1393. Do.—Mr. W. Griffiths,† Ingleside, Prospect Road. 3. 5.35. 4. a combination of lifting and side-rolling. c. yes. 5. 5 or 6 secs. 6. 6. In the room above (wh. is fitted as a gymnasium) are two iron rings hanging by two cords ab. $1\frac{1}{2}$ yards long and ab. 15 inches apart, while there is a post ab. a foot from one of them, all three being in a line nearly N. and S. Imm. the shock and noise in the room ceased, these rings were distinctly heard to clank three times either against one another or against the post. 7. a rumbling noise. c. p. a little.

1394. Do.—Mr. C. E. Iles,† St. Agnes. 3. ab. 5.33. 4. movement both up-and-down and sideways. 6. < 4. 7. no.

1395. Do.—Mr. H. R. Stubbs, Braunston, Sandford Road. 3. 5.35. 4. two series, the first an upheaval, and the second a tremor like that produced by a heavy vehicle passing. 6. 5. 7. a heavy vehicle passing.

1396. Do.—Mrs. Bishop,* Glenthorne, Strensham Road. 3. 5.34. 6. 5 or 6. 7. something like the roar of a chimney on fire when there is a strong draught. b. p.

1397. Do.—Mr. W. Priest,* Wake Green Road. 3. just after 5.30. 4. a rocking, 3 times to and fro. g. a little E. of N. and a little W. of S. 5. ab. 3 secs. 6. pr. 5. 7. a noise as of a distant explosion, the interval bet. the so. and sh. ab. 1 or 2 secs.

1398. Do.—Mr. C. Brazier,* Wake Green Road. 3. ab. 5.30. 4. only one series, a trembling sensation (the obs. walking). 5. ab. 6 secs. 6. the trees were shaken as if by a sudden gust of wind. 7. a heavy vehicle in the distance. b. p. ab. 1 or 2 secs.

1399. *Saliley*.—Mr. S. B. Barton-Eckett,† 21 Highfield Road. 3. 5.35. 6. 4.

1400. *Selly Hill*.—Mr. F. S. Pearson.* 3. 5.32. 4. two shs., the first stronger. 6. pr. 6 (int. of second sh. 4). 7. (acc. to another obs.) a loud rumbling noise entirely before the sh.

1401. *Selly Oak*.—Mr. W. F. Raybould,* Middle Park Farm. 3. 5.30. 4. a severe shake of the bed, with what appeared like a twisting sensation from S.E. to N.W. 5. ab. 12 secs. 7. a peculiar rumbling noise, acc. with a curious wind. b. p. a few secs.

1402. Do.—Mr. J. Reid,† South View, Heeley Road. 3. 5.32. 4. a series of lurches backwards and forwards for ab. 3 secs., dying away in a faint

tremor also lasting ab. 3 secs. ; the windows rattled only with the trem. mot. 5. ab. 6 secs. 6. 5. 7. a so. as of distant thunder, wh. seemed to die away as soon as the violent motion commenced.

1403. *Smethwick*.—Mr. H. Astbury, The Beeches. 3. 5.32. 4. a violent shaking backwards and forwards. g. N.W. to S.E. 5. ab. 20 secs. 7. a sudden gust of wind through trees ; the so. entirely p. the sh.

1404. Do.—Rev. H. T. Tilley, St. Mary's Vicarage, Bearwood. 3. 5.34. 4. the bed gave a lurch as if lifted, and afterwards continued to rattle for ab. 10 secs. 6. 5. 7. a so. like that of distant thunder, heard after the sh. c. f. 3 or 4 secs.

1405. *Spring Hill*.—Nurse Horton. 3. 5.35. 6. 5. 7. a loud rumbling noise for ab. 8 or 10 secs.

STAFFORDSHIRE

1406. *Abbots Bromley*.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. bet. 5.30 and 6 A.M. 5. nearly half a min. 6. 5.

1407. *Alton*.—(Do.) 3. bet. 5 and 6. 4. a swaying or rocking motion. 6. 5. 7. the sh. acc. by a dull rumbling noise.

1408. *Ashley*.—(c. by Rev. J. L. Spencer.) 3. ab. 5.30. 4. only one sh. 5. ab. 15 secs. 6. 5. 7. no.

1409. Do.—(*Staffordshire Sentinel*, Hanley, Dec. 19.) 3. ab. 5.30. 6. 5.

1410. *Audley*.—(Do.) 4. four shs. f. by distinct vibra. and a slight upheaval. 6. 5.

1411. *Bilbrook*.—Mrs. Cornforth.* 3. bet. 5.30 and 5.35. 4. as if some one under the bed raised it and then moved it from foot to head twice. 5. ab. 4 secs. 6. 6? 7. no.—A large jorum in the pantry standing on the floor, 12½ inches deep and 13 inches across and containing 5 gallons of water, was previously brim-full, and was afterwards found half empty and the pantry floor was flooded.

1412. *Bobbington*.—Rev. T. W. Wasdale-Watson.† 3. 5.35. 4. a shaking of the bed as if by some one underneath it. 5. ab. 3 secs. 6. 5. 7. no.

1413. *Branstone*.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) Some draymen, passing near the bridge at Branstone, noticed their carts rocking. 5. a few secs. 6. 5. 7. the sh. was acc. by a rumbling noise.

1414. *Brewood*.—Anon.† (c. by Rev. E. J. Wrottesley). 3. 5.30. 6. < 4.

1415. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. ab. 5.30. 6. < 4. 7. the sh. was acc. by a rumbling so.

1416. *Brierley Hill*.—(*County Express*, Stourbridge, Dec. 19.) 3. 5.30 or 5.35. 6. 5.

1417. *Burslem*.—Dr. S. King Alcock.* 3. 5.35. 4. d. yes. e. mid. g. direction ill-defined, but pr. N. and S. 5. ab. 8 secs. 6. < 4. 7. no.

1418. *Burton-on-Trent*.—Mr. H. E. Bridgman. 3. 5.35. 4. the bed oscillated evenly from side to side, i.e. N. and S. 5. ab. 8 secs. 6. 5 or 6. 7. no.

1419. Do.—(*Birmingham Daily Post*, Dec. 18.) 3. 5.40. 4. six marked tremors. g. N. to S. 6. 5.

1420. *Chasetown*.—Mr. G. F. Reader. 3. bet. 5.30 and 5.45. 4. an upheaval of the bed, the N.E. side rising a little faster than the other, and then a sharp rotary shake, as though the bed were pivoted in the middle, afterwards a few slight shakes as if recovering equilibrium. 6. 5. 7. no.

1421. *Cheadle*.—Anon.* (c. by Rev. E. S. Carlos). 3. 5.30. 5. 2 or 3 secs. 6. < 4. 7. no.

1422. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. ab. 5.30. 6. < 4. 7. a rumbling noise f. the sh.

1423. Do.—(*Staffordshire Sentinel*, Hanley, Dec. 19.) 5. a few secs. 6. 5.

1424. *Codsall*.—Mr. E. D. Martin, C.E.* 3. ab. 5.33 or 5.35. 6. < 4.

1425. *Colwich*.—Mr. W. F. Tunbridge.* 3. ab. 5.33. 6. < 4. 7. a rumbling noise, like snow sliding off the roof (but without the thud on the ground), f. the sh.

1426. *Compton*.—L. Nokes.* 3. 5.36. 4. two shs., the first stronger, separated by an interval of 2 secs. during wh. a trem. mot. was felt. 5. ab. 12 secs. 6. 5. 7. thunder rumbling in the distance; the so. p. the sh. by ab. 3 secs. and lasted during the first sh. but died away before the second.

1427. *Coseley*.—(*Birmingham Daily Gazette*, Dec. 18.) "At Hurst Hill, Coseley, considerable damage was done to cottage property. The sudden shock caused walls to give way."

1428. *Denstone*.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. bet. 5.30 and 6. 4. two most sharp shocks.

1429. *Eccleshall*.—Rev. W. Allen.† 3. 5.32. 4. a. yes, 5 or 7 secs. d. yes f. no. 5. 10 to 15 secs. 6. pr. 5. 7. a great "clump" of thunder, and then a noise like a threshing-machine and engine passing. b. p. imm. c. pr. p.

1430. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. 5.32. 4. g. S.E. to N.W. 5. 2 or 3 secs. 6. 6?

1431. *Ellastone*.—Mr. R. Burrell.† 3. 6.34 [*sic*]. 4. the vibrs., in wh. there was no break, seemed to cease suddenly. 5. ab. 5 secs. 6. 5.

1432. *Elmadale*.—Anon.† 3. 5.33. 4. the wall at the N. end of the room shook as if something heavy had fallen in the next room, and imm. the bed rocked violently from E. to W. six distinct times, the last oscillation ending with an upward movement and then a rapid downward one. 5. ab. 20 or 30 secs. 6. < 5. 7. the sh. was p. by a rushing so., as of a mighty wind from N.E. to S.W., and then a rumbling noise acc. the vibrs., and the roar of it grew in int. so as to be almost deafening, when it ended with a loud dull thud coincident with the vert. mot.

1433. *Fradley*.—Mr. C. W. Upton.* 3. 5.35. 4. continuous vibrs. of a jarring nature, ab. 3 secs. c. yes. 6. pr. 4. 7. a heavy dray passing. b. p. 2 or 3 secs.

1434. *Goldenhill*.—Dr. A. J. Currie. 3. 5.35. 4. continuous tremor, two max., the first stronger and of longer duration. 5. < a min. 6. 5. 7. no, but another obs. heard a noise as of a cannon at the beg.

1435. *Grindon*.—Mr. S. A. White.† 3. ab. 5.40. 4. according to another obs., the movement ceased for a sec. or so, and then recommenced. g. pr. E. and W.

1436. *Hanley*.—Mr. W. H. Folker.* 3. ab. 5.40. 4. 5 or 6 vibrs.

of ab. the same int. f. no. g. ab. N. and S. 5. ab. 5 or 6 secs. 6. pr. 5. 7. no.

1437. *Hednesford*.—Mr. N. Chandler. 3. 5.32. 4. slow horizontal vibra. grad. decreasing in int. g. N.E. to S.W. 5. ab. 4 secs. 7. no.

1438. *Kingswinford*.—Mr. J. Walker.* 3. bet. 5.32 and 5.33. 4. the bed was tilted, as if some strong man underneath were trying to raise it, first on the E. side, then on the W., and again on the E. side. 6. 5. 7. so. heard. b. p. c. f.

1439. Do.—(*County Express*, Stourbridge, Dec. 19.) 3. bet. 5.30 and 5.35. 4. a violent shaking. 7. a heavy rumbling so.

1440. *Kinver*.—Miss J. M. Lee.* 3. bet. 5.30 and 5.40. 6. 5. 7. a rumbling so.

1441. Do.—(*County Express*, Stourbridge, Dec. 19.) 3. ab. 5.40. 6. 5. 7. a distinct rumbling so. like that of a cart or heavy carriage driven rapidly; this lasted several secs. and was f. after an interval by an upheaving movement.

1442. *Leek*.—(*Leek Times*, Dec. 19.) 3. 5.35. 4. g. S.E. to N.W. 5. ab. 5 secs. 6. 6.

1443. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. ab. 5.30. 4. g. E. and W. 5. ab. 30 secs. 6. pr. 5. 7. a rumbling so.

1444. *Lichfield*.—Rev. C. N. Bolton. 3. 5.37. 4. three distinct leaps, 3 or 4 secs., f. by trem. mot. ab. 3 secs. e. mid. 5. 6 or 7 secs. 6. 5: a garden wall fell in the Close. 7. a rumbling, as of subterranean thunder, p. the sh. and ceased before it.

1445. Do.—(*Birmingham Daily Gazette*, Dec. 18.) 3. ab. 5.35. 4. a swaying motion. 6. 4 5. "In one case a mirror was displaced . . . while crockery is reported to have been broken at various localities. The clock at the National Provincial Bank was stopped by the shock." 7. a railway-train in a tunnel.

1446. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) "Although the shock was undoubtedly severe, it is remarkable that little or no damage was done. The only case, we believe, is that of a wall in the garden . . . at the corner of the Close and Beacon Street, which fell with a somewhat loud crash at the time of the shock."

1447. *Longton*.—Mr. E. Haigh.† 3. ab. 5.30. 4. two sha., the first stronger, separated by only a few secs. g. N. and S. 6. pr. 5. 7. no.

1448. Do.—Mr. W. W. Hulse.* 3. ab. 5.35. 5. ab. 4 secs. 6. 5. 7. no.

1449. *Newcastle-under-Lyme*.—E. Ashworth.† 3. ab. 5.30. 4. the bed violently shaken from side to side, as if by some one grasping the legs. 6. 5.

1450. Do.—(*Staffordshire Sentinel*, Hanley, Dec. 19.) 3. 5.35. 6. 5.

1451. *Ocker Hill*.—Mr. H. Friend. 3. 5.40. 4. a gentle rhythmic rocking motion, occurring four times. g. S. to N. 5. ab. 3 secs. 6. 5. 7. no distinct noise heard.

1452. *Pattingham*.—Miss H. Hawley.† 3. ab. 5.40. 4. the bed shook violently from side to side. 5. 10 secs. 6. 5. 7. a rushing noise and a rumble. b. p.

1453. *Penkridge*.—Mr. R. R. Murphy.† 3. ab. 5.36. 4. a wavy motion

of the bed, as though it were shaken by two strong men. g. E.N.E. to W.S.W. 5. 5 to 6 secs.

1454. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. 5.35. 4. a shaking of doors and windows, f. by a low rumbling noise; then, after two or three secs. of profound stillness, another tremor wh. shook beds and other furniture, and seemed to travel from W. to E. 6. \leftarrow 4. 7. a low rumbling noise, f. by a sudden gust of wind [*sic*].

1455. Penn.—Mr. A. H. Harrison.* 3. 5.30. 4. two distinct oscillations, separated by an interval of 3 or 4 secs.; during the first sh. the bed oscillated a little; with the second, wh. was decidedly the stronger, the bed was heaved up and swayed. 5. ab. 5 or 6 secs. 6. 5.

1456. Pensnett.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) "Several chimneys were cracked and partly thrown down" (see next observation).

1457. Do.—(*County Express*, Stourbridge, Dec. 19.) 6. 5, "no damage appears to have been sustained."

1458. Perry Barr.—Anon.† (c. by Mr. H. P. Trueman). 4. three or four distinct rolls, diminishing in range. 6. 5. 7. a traction-engine or train passing; the last roll occurred in silence.

1459. Do.—Anon.* 3. bet. 5.40 and 5.45. 6. 5. 7. a tremendous noise, wh. lasted ab. 6 secs. and seemed to come from the S.

1460. Rocester.—Mr. L. E. Hurt.† 3. ab. 5.35. 6. 5. 7. a heavy growl seemed to pass under the house; it acc. the sh. and, as it ceased, appeared to pass off towards the W.

1461. Rugeley.—Mr. F. K. Woodroffe. 3. 5.33.* 4. two distinct shs., the first strong and lasting 3 secs., and, after an interval of 7 to 10 secs., a second faint and momentary sh. 6. 4.

1462. Do.—Rev. A. Moncrief.† 3. 5.33½.* 4. only one max., 3 or 4 vibra per sec., the movement dying away rather rapidly. f. no. 5. 5 to 8 secs. 6. 5. 7. no; but, from inquiries made in many directions, it seems to have been heard by a few and to have p. the vibra.

1463. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. ab. 5.40. 6. \leftarrow 4. 7. a low rumbling so.

1464. Sedgley.—(*Dudley Herald*, Dec. 19.) 6. \leftarrow 5, numerous ceilings were badly cracked.

1465. Shareshill.—Anon.* (c. by Rev. R. Butcher). 3. ab. 5.30. 4. two series of vibra., the first of wh. appeared the stronger; the bed rose considerably on one side for a few secs. and then subsided. g. E. to W. 5. pr. half a min. 6. 5. 7. no, but another obs. heard a so. like snow falling off the roof.

1466. Shelton.—Mr. C. E. de Rance, F.G.S. (*Staffordshire Sentinel*, Hanley, Dec. 19.) 3. ab. 5.40. 4. g. S.W. to N.E. 7. the sh. was acc. by a peculiar rushing so.

1467. Do.—(Do.) 6. 5.

1468. Stafford.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. 5.30. 4. a rather violent shaking, as if a very heavy steam-roller were passing, f. by a tremor or oscillating movement wh. lasted 5 or 6 secs.

1469. Stoke-upon-Trent.—Mr. F. Bache, F.G.S.† (c. by Dr. Wheelton Hind, F.G.S.). 3. 5.35. 4. two max. of int., separated by an interval of 3 or 4 secs., the second the more intense. 5. ab. 6 or 7 secs. 6. pr. 5.

7. a rushing so. b. p. c. p. d. yes. e. p.; there was no so. during the second sh.

1470. Do.—Mr. R. Alcock.† 4. a trem. mot. d. yes. e. mid. f. yes. 6. 5. 7. no.

1471. Do.—(*Staffordshire Sentinel*, Hanley, Dec. 19.) 6. < 5.

1472. *Stone*.—Rev. A. E. Brisco Owen.† 3. 5.35. 4. d. yes. e. mid. f. no. 5. 4 or 5 secs. 6. 5. 7. a heavy cart going down the street. b. p.

1473. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. ab. 5.30. 6. 5?

1474. *Tamworth*.—(*Tamworth Herald*, Dec. 19.) 3. ab. 5.30. 4. beds were rocked from side to side. 6. 5. 7. the sh. was acc. by a rumbling so.

1475. Do.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 3. 5.40. 4. three distinct upheavals. 5. ab. 10 secs.

1476. *Tatenhill*.—(c. by Rev. T. Roper.) 3. ab. 5.30. 4. two horizontal vibra., the one closely following the other. 6. pr. 5.

1477. *Teddesley Hall*.—Mr. A. C. Littleton.† 3. ab. 5.33. 4. a rattling of furniture and of pictures against the wall, f. by an upheaval. g. S.S.E. to N.N.W. 6. 5.

1478. *Trysull*.—Rev. J. W. Andrews. 3. 5.35. 4. d. yes. 5. ab. 10 secs. 6. 5. 7. no, but those out of doors seem to have heard a rumbling so.

1479. *Tunstall*.—(*Staffordshire Sentinel*, Hanley, Dec. 19.) 3. 5.37. 6. 5.

1480. *Upper Gornal*.—Rev. W. A. H. Lewis.† 3. ab. 5.35. 4. two series, the second stronger, separated by a lull of 2 or 3 secs.: the bed swayed, the motion being like that of a bricklayer's riddle. 5. 10 secs. 6. 5. 7. a loud rumbling almost like a succession of blows beneath, and, after this ceased, a noise something like that of a violent wind.

1481. *Upperhulme*.—Mr. J. W. Robinson.* 3. 5.40. 4. the motion like that of a bed shaken by some one holding the bed-foot. g. N. to S. 5. 2 secs. 7. a rumbling noise heard.

1482. *Uttoxeter*.—Anon.† 4. a great lurch and then the bed rocked backwards and forwards ab. 15 times. 6. pr. 5. 7. a booming cannon.

1483. *Walsall*.—Miss E. Aldis* (c. by Mr. J. A. Aldis). 3. 5.35. 4. a trem. movement for 4 or 5 secs. then 3 or 4 big swings. f. no. g. S.W. to



FIG. 4.

N.E. 5. 6 or 7 secs. 6. 5. 7. a curious rhythmical so. or low humming beats a few secs. before the trem. mot. began, the so. ended with the max. sh. approximately.

1484. Do.—Mr. F. Sheaden. 3. ab. 5.30. 4. one series of vibra. wh. grad. died away; on a shelf in my laboratory running N. and S. covered with bottles, the dust-marks showed that they had all slightly moved in one

direction, namely, S.W. 5. a few secs. 7. a rumbling so. like the passing of a heavy cart, imm. before the beg. of the sh.

1485. Do.—Mr. G. Overton. 3. ab. 5.35. 4. g. S.E. to N.W. 5. > 10 secs. 6. 5.

1486. Do.—A. Hopley.* 3. ab. 5.30. 4. oscillations for ab. 3 secs, f. by an upheaval of the bed. g. S.W. to N.E. 6. 5. 7. a rumbling noise from the S.W., like an explosion. b. p. ab. 3 secs.

1487. Do.—(*Birmingham Daily Gazette*, Dec. 18.) 3. 5.31. 4. a vigorous shake, f. after a momentary pause by a slight quiver. f. yes. 6. 5 or 6. 7. a heavy traction-engine along the street. b. p.

1488. *Wednesbury*.—Anon.* (c. by Mr. E. M. Scott). 3. ab. 5.20. 4. g. S.W. to N.E. 5. 4 or 5 secs. 6. 5. 7. the sh. grad. died away with a rumbling so. like that heard in the distance after blasting operations at a slate quarry.

1489. Do.—Mr. F. W. Hackwood, J.P.† 3. 5.30. 4. a violent up-lifting of the bed, f. by oscillations for some secs. 6. 5.

1490. *Weston*.—Mr. J. T. Poole.* 3. 5.32. 4. a continuous trem. mot., without any apparent difference of int. 5. 12 to 15 secs. 6. pr. 4. 7. distant thunder, the so. c. with the sh.

1491. *Westwood Hall*.—Mr. J. Robinson, F.R.Met.S. 3. 5.34. 5. ab. 4 secs. 6. < 4. 7. no.

1492. *Wolverhampton*.—E. Tonks.* 3. ab. 5.40. 4. the bed suddenly rose and fell very quickly 3 or 4 times; after a second's pause, the bed vibrated from W. to E., at first violently and then grad. subsiding to a faint trembling. 5. ab. 30 secs. 6. 6. 7. another obs. was awakened by a violent bumping so. like heavy bales falling. b. p.

1493. Do.—Rev. A. Phillimore.* 3. just after 5.30. 4. 6 or 7 rapid vibra. from side to side, all app. of the same int. 5. 3 secs. 6. < 4. 7. a heavy cart passing along the street. b. c? c. f. d. yes. f. no.

1494. Do.—Mr. J. C. Bell.† 3. 5.37. 4. a clear, distinct and regular series of oscillations, about 80 per minute. g. N. and S. 5. 10 secs. 6. 5. 7. after the sh., a slight so. like the moaning of wind.

1495. Do.—Mr. E. Elliott. 3. 5.32. 4. several undulatory vibra., p. by trem. mot. 5. ab. 10 or 15 secs. 6. 5. 7. the passing of a steam-roller; the so. entirely p. the sh. by ab. 1 or 2 secs.

1496. Do.—E. Bone.* 3. ab. 5.35. 4. the movement was as if some one underneath the bed were lifting it on his shoulders. g. S. to N. 5. ab. 18 or 20 secs. 6. 5. 7. no.

1497. Do.—(*Daily Chronicle*, Dec. 18.) 3. 5.30. 4. a succession of vibra. from E. to W. 5. ab. 15 secs. 6. 5.

1498. *Wombourne*.—Miss H. A. Heale.† 3. ab. 5.35. 4. a. yes, ab. 3 secs. b. then more intense vibra., and, after a pause of one sec., a gentle but unmistakable quiver first towards the W. and then towards the E. 6. 5. 7. a traction-engine passing the house, the so. p. the sh. and stopped when the vibra. began.

1499. *Wordsley*.—(*Staffordshire Advertiser*, Stafford, Dec. 19.) 6. 7?

CHESHIRE

1500. *Alderley Edge*.—Mrs. Dambrill-Davies.* 3. 5.36 A.M. 4. a slide forward from S.S.E. to N.N.W. with a sudden jerk back, this repeated 4 or 5 times. 6. 5. 7. no.

1501. *Altrincham*.—Mr. E. Pickard.† 3. 5.34. 4. the bed swayed steadily from side to side 5 or 6 times, the last vibr. but one being weaker than the others, giving the idea of a lull. 5. $1\frac{1}{2}$ secs. 6. 5. 7. no.

1502. Do.—L. Salisbury* (*Manchester Courier*, Dec. 21). 3. 5.40. 4. the bed rocked 4 times from E. to W., but, both before and after the rocking, ornaments rattled loudly. 6. 5. 7. a hissing so. as of steam escaping, then a rushing and dull thud as though thick snow had fallen off the roof to the ground; the eq. died away with a so. as of distant thunder.

1503. *Ashton-on-Mersey*.—(c. by Mr. T. B. King.) 3. ab. 5.35. 4. two sha., the first stronger. 6. 4.

1504. *Audlem*.—(*Warrington Daily Guardian*, Dec. 18.) 3. bet. 5.30 and 5.45. 6. 5.

1505. *Bidston*.—Rev. J. F. Buckler.* 3. 5.35 to 5.37. 4. ab. 7 vibrs. of ab. the same int. f. yea. 5. ab. 7 secs. 6. 5.

1506. *Birkenhead*.—Mr. W. Lownsbrough.* 3. 5.30. 4. one vibr. f. by trem. mot. 5. ab. 10 secs. 6. pr. 5. 7. no.

1507. Do.—Miss E. Hibbert. 3. ab. 5.40. 4. the vibra. like those caused by a heavy traction-engine or luggage-train. 5. ab. 10 secs. 6. 4. 7. no.

1508. Do.—(*Liverpool Courier*, Dec. 18.) "In Tranmere and the higher portions of the district, windows were broken in several instances, while in several of the nurseries about Oxton and Claughton the greenhouses suffered to a considerable extent."

1509. *Birkenhead Park*.—Mr. S. Eddowes (c. by Mr. J. Lomas). 3. 5.32. 4. f. no. 5. 5 to 6 secs. 6. < 4. 7. no.

1510. *Bowdon*.—Mr. M. Stirrup.† 4. a vibratory motion like that produced by a traction-engine. g. E. and W.

1511. Do.—Mr. J. Smith (*Manchester Courier*, Dec. 18). 3. ab. 5.30. 4. three distinct sha., the motion like that of a passing wave. 6. 5.

1512. *Brinnington*.—Mr. W. H. Deanilee. 3. 5.36. 6. 5. 7. a noise like shunting on the railway before the sh., wh. was followed by another noise slightly resembling distant thunder, wh. passed away at great speed southwards.

1513. *Burwardsley*.—Rev. F. R. Wansbrough.* 3. 5.35. 4. ab. 12 vibrs., of ab. the same int., the bed swayed evenly. f. no. 5. ab. 3 secs. 6. 5. 7. no.

1514. *Cheadle*.—M. B. Dugley. 3. bet. 5.30 and 5.35. 4. ab. 5 or 6 vibrs. g. N. and S. 6. 5.

1515. *Cheadle Hulme*.—(*Manchester Courier*, Dec. 18.) 3. 5.30. 4. g. E. to W. 5. ab. 10 or 15 secs. 6. 5.

1516. *Chester*.—Mr. H. Duckworth.* 3. ab. 5.30. 4. two sha. in rapid succession; there was a jolting sensation like that experienced in a bathing-

and 5.35. 5. several secs. 6. 5. 7. a loud and prolonged rumbling as of thunder.

1554. Do.—(*Liverpool Courier*, Dec. 18.) 6. 5.

1555. *Rockferry*.—Mr. E. W. Cox.* 4. the motion, though quick, was not harsh, and resembled the jolting of a well-sprung carriage over an uneven but not rugged road: the first undulation was the strongest, and this was followed by 3 minor and 3 major undulations alternately; they ceased suddenly with a kind of slight shiver. g. W. to E. with an apparent tendency to N.W. 5. 6 or 7 secs. 6. 5. 7. at the first undulation there was a very deep, but not loud, humming noise, resembling the deepest bass note of a large organ played rather softly; imm. the sh. passed away, the so. changed entirely and could be heard passing eastward, with a sharper noise like the rushing of the sea wh. died grad. away.

1556. Do.—Mr. W. H. Nicholson. 3. 5.33. 4. one series of vibra. 5. 15 to 20 secs. 6. 5.

1557. Do.—Mr. J. C. Boston.† 3. 5.36. 4. a rather sharp swinging motion. 5. ab. 6 secs. 6. 5. 7. a peculiar rushing so.

1558. Do.—Mr. H. Eccles † (c. by Mr. J. Lomas). 4. g. N. and S. 5. ab. 6 to 10 secs. 6. 5.

1559. Do.—(c. by Mr. E. W. Cox.) 4. two shs. felt at an interval of 2 to 3 mins [*sic*], the second sh. the fainter. 7. the noise weaker with the second sh.

1560. *Runcorn*.—Mr. A. Timmins.* 3. 5.30. 5. very few secs. 6. < 4. 7. no.

1561. Do.—Mr. Buck † (*Manchester Guardian*, Dec. 18.) 6. 5.

1562. *Salé*.—Anon.* (Do.) 3. ab. 5.30. 4. motion lateral g. E. to W. 5. 1 or 2 secs. 6. < 4.

1563. Do.—(*Stalybridge Reporter*, Dec. 19?) 4. a lateral shaking. 6. 5.

1564. *Sandbach*.—Rev. J. R. Armitstead. 3. ab. 5.45. 4. a trem. mot. like that made by a man or large animal under the bed. 5. ab. 30 secs. 6. < 4. 7. no.

1565. *Seacombe*.—Mrs. E. Shilston.† 3. 5.35. 4. two shs. of equal int.; during the second sh. the jug rattled in the basin. f. yes. g. N. and S. 6. 5. 7. a rumbling like a clap of thunder c. with the sh.

1566. *Spital*.—(*Liverpool Courier*, Dec. 18.) 3. 5.36. 4. two waves, wh. seemed to travel from N. to S. 5. 5 or 6 secs. 6. 5.

1567. *Swettenham*.—Mr. R. Whenery. 3. ab. 5.30. 4. an upward heave and noise wh. died away, f. by another heave with lateral motion afterwards. 5. 4 to 5 secs. 6. 5. 7. b. f. 2 secs. f. no.

1568. *Tarporley*.—Anon. 3. ab. 5.30. 5. several secs. 6. < 4: in one instance ornaments were shaken down.

1569. *Tarvin*.—(*Chester Chronicle*, Dec. 19.) 6. pr. 5.

1570. *Tilstone*.—Rev. A. Grier.† 3. ab. half-way bet. 5.30 and 5.35. 4. a continuous movement of the bed as if some one were underneath moving it with his back. 5. ab. 4 secs. 6. 5. 7. no.

1571. *Timperley*.—Mr. W. B. Brown. 3. 5.35. 4. 3 distinct shs., the first and third being ab. equal, the second lasting as long as the other two together and much more decided. 5. ab. 4 secs. 6. 5. 7. no, but another

obs. heard a noise as if a load of bricks were tipped against the end of his house.

1572. *Do.*—Mr. G. A. Falkner. 3. 5.35. 4. 4 or 5 vibra. 5. 5 secs. 6. 5.

1573. *Vicar's Cross.*—Mrs. P. Campbell† 3. 5.35. 4. ab. 5 horizontal vibra. of equal int. 6. pr. 5. 7. no: but by another obs. the so. was heard.

1574. *Wallasey.*—Anon.† (*Liverpool Daily Post*, Dec. 18). 3. 5.30 4. two very distinct vibra., the second following the first imm. 7. a noise like that wh. p. a violent storm of wind.

1575. *Waverton.*—Mr. J. Dean† (*Chester Chronicle*, Dec. 19). 3. 5.40. 4. two series of vibra.

1576. *Wilmslow.*—Mr. W. Mann† (*Manchester Courier*, Dec. 18). 3. 5.35. 4. a continued vibr. 6. pr. 5.

1577. *Winnington Mount.*—Mrs. A. H. Marsh. 3. ab. 5.40. 4. one series. 5. 3 or 4 secs. 6. 5. 7. a rumbling imm. after the sh.

1578. *Wrenbury.*—Rev. T. W. Norwood.† 4. a rocking motion of the bed; according to other observers, there were two distinct sha. 6. 5. 7. a heavy rumbling so.

FLINTSHIRE

1579. *Bettesfield.*—Mr. J. Roberts (c. by Mr. C. S. Dennis). 3. 5.30 A.M. 4. a rolling motion. 5. 2 secs. 6. 5. 7. before the sh. a rumbling so. like that of empty carriages detached and slowly approaching the station, and imm. before the sh. a so. like that of a strong gust of wind.

1580. *Cilcain.*—Rev. J. Felix.* 3. 5.35 or 5.40. 4. a heaving of the bed. g. E. to W. 6. 5. 7. a cart on the road outside the house.

1581. *Ewloe.*—Mrs. J. Fox* (c. by Mr. J. Lomas). 3. 5.40. 4. as there was a light in the room, the obs. could see, as well as feel, the bed distinctly rocking. g. E. to W. 5. quite 10 secs. 6. 5. 7. a loud rushing so. as of wind and thunder. b. p.

1582. *Fenns Bank.*—Anon.* (c. by Mr. C. S. Dennis). 3. 5.30. 4. a. yes, ab. 20 secs. b. 3 vibra., one sec. each. c. yes, ab. 30 secs. f. no. 6. < 4. 7. a train passing. b. c. c. c. d. yes. e. p., ab. 10 secs. f. no.

1583. *Flint.*—Mr. Hugh Owen† (c. by Mr. J. Lomas). 3. 5.34. 4. as if the bed were lifted underneath, apparently ab. 2 inches. 5. 5 or 6 secs. 6. 5. 7. a deep, dull rumbling, like heavy vehicular traffic passing, but duller.

1584. *Halkyn.*—Capt. F. S. Williams† 3. ab. 5.30. 4. d. yes. e. mid. 5. ab. 30 secs. 6. 5. 7. d. yes. e. c.

1585. *Hawarden.*—Dr. D. C. Burlingham.† 3. ab. 5.30. 4. as if the house were suddenly lifted up and then let down again. 6. 5.

1586. *Meliden.*—Mr. P. W. Williams.* 3. 5.35. 4. a slight preliminary vibr. without any noise; succeeded in ab. 2 to 3 secs. by a loud rushing noise and a slight heaving and distinct vibr. of the bed, whose duration was > 6 or 7 secs. 7. a rushing noise, as of wind in a forest, closely p. the second or main vibr. and died away with it.

1587. *Mold*.—(*Chester Chronicle*, Dec. 19.) 6. 5.
1588. *Nantlys*.—Mr. P. P. Pennant.† 4. a continuous vibr., with two max., at beg. and end, of ab. the same int. f. no. 5. 2 or 3 secs. 6. pr. 5. 7. no, though the so. was noticed by other observers.
1589. *Nerquis*.—"F. F." (*Liverpool Courier*, Dec. 19). 3. 5.40. 4. a smart sh. 7. the sh. acc. by a rumbling so.
1590. *Northop*.—Anon.† (c. by Rev. Canon T. Richardson). 3. 5.15. 4. 6 vibra., of equal int., as if some one were underneath the bed, lifting and tilting it. 5. ab. 10 or 12 secs. 6. 5. 7. a rumbling so.
1591. *Do*.—(*County Herald*, Holywell, Dec. 24.) 3. ab. 5.36. 5. ab. 6 secs. 6. 5?
1592. *Prestatyn*.—Mr. J. T. Dawes.* 3. 5.31½. 4. 3 distinct quiverings, following imm. one upon another, not more than half a sec. between each. g. pr. N.W. to S.E. 5. > 10 or 12 secs. 6. 5. 7. no.
1593. *Rhuddlan*.—Rev. T. W. Vaughan.† 3. ab. 6.35 [*sic*]. 4. a heaving of the bed, as if some one were underneath, and then a severe shaking. d. yes. e. mid. 5. perhaps 10 to 20 secs. 6. 5. 7. c. f. ab. 2 secs. d. yes.
1594. *Rhyl*.—Mr. J. Wood.* 3. ab. 5.45. 4. as if shaken by some one roughly; then a movement of the bed, f., after a brief interval, by the rattling of the window facing S. 5. > 3 secs. 6. 5. 7. no.
1595. *Do*.—(*Daily Chronicle*, Dec. 18.) 4, 7. a low moaning so., after wh. the earth shook violently.
1596. *St. Asaph*.—Anon. (c. by Mr. B. Cunliffe). 3. 5.35. 5. 3 or 4 secs. 6. 5.

DENBIGHSHIRE

1597. *Abergele*.—Rev. D. Evans.* 3. 5.35 A.M. 4. continuous vibra. d. yes. e. mid. 5. ab. 30 secs.
1598. *Chirk*.—Rev. E. J. Evans.† 3. 5.35. 4. a continuous succession of ab. a dozen pushes or throbs. 5. ab. 5 or 6 secs. 6. 5. 7. no, but others heard slight rumblings.
1599. *Coed-y-Glyn*.—(c. by Sir R. E. Egerton.) 3. ab. 5.30. 4. sh. felt. "We now observe some cracks in a wall which divides rooms on the E. side of the house. The direction of the wall is E. and W. The cracks seem recent and none of us remember seeing them before. I think the cracks have been increased, if not caused, by some recent movement."
1600. *Colwyn Bay*.—Mr. J. W. Richards.† (c. by Mr. A. O. Walker). 3. 5.30. 4. b. 2 vibra., 1 or 2 secs. c. yes. f. no. 6. 5. 7. a rushing so. f. by a kind of moaning noise.
1601. *Do*.—Mr. J. R. Bernard (c. by Mr. J. Lomas). 3. 5.30. 4. g. E. to W. 6. 5. 7. (acc. to other observers) the so. was like that of the firing of heavy guns or the noise of blasting in quarries.
1602. *Denbigh*.—Anon.† (*Denbighshire Free Press*, Denbigh, Dec. 19). 3. soon after 5.30. 5. at least 15 secs. 6. < 4. 7. the so. at first as if something heavy had fallen in the next room.
1603. *Derwen*.—Rev. M. Hughes. 3. bet. 5 and 6. 5. a few secs. 6. < 4.

1604. *Galltfaenan*.—Mr. J. P. Pritchard * (*Denbighshire Free Press*, Denbigh, Dec. 19.) 3. 5.35. 4. g. N. and S. 5. fully 10 secs. 6. 5.
1605. *Garn*.—Mr. W. D. W. Griffith. 3. 5.40. 4. sh. felt. 7. no.
1606. *Gresford*.—Miss J. M. Newcome.† 3. bet. 5.30 and 5.40. 4. 2 shs., separated by an interval of several secs.: the first sh. by far the longer (perhaps 10 or 12 secs.), the bed rocked from side to side; the second sh. seemed to give only one slight rocking movement. 6. 5. 7. no.
1607. Do.—(*Chester Chronicle*, Dec. 19.) 4. the house shaken. 7. a loud rumbling noise.
1608. *Holt*.—Anon.* (c. by Mr. J. Lomas). 4. as if some one were lifting the bed and shaking it violently. 6. 5. 7. a peculiar hissing so, as if made by trees, grad. gaining in volume as it drew nearer, until it sounded as if a cart were passing over the farmyard pavement.
1609. Do.—Mr. J. T. Sheppard (c. by Mr. J. Lomas). 3. 5.30. 4. the bed trembled. 7. as if a cart were going out of the yard.
1610. *Llangollen*.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 3. ab. 5.30. 6. 4 5.
1611. *Maes Eloy*.—Mrs. Birch.† 3. ab. 5.15. 6. 5. 7. the so. of a large dog scratching itself.
1612. *Pentre Voelas*.—Rev. G. Williams* 3. ab. 5.30. 4. a. yes, ab. 1 sec. b. 2 shs., the first lasting ab. 4 secs. d. yes. e. mid. 6. 5. 7. a rumbling so. like a deep foghorn. d. loud at first and died away with the vibr.
1613. *Penycae*.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 6. 4 5. 7. a rumbling noise.
1614. *Plas-y-nant*.—(*Denbighshire Free Press*, Denbigh, Dec. 19.) 3. 5.35. 4. g. E. and W. 5. ab. 5 secs. 6. pr. 5.
1615. *Rhewl*.—Mr. J. W. Kershaw.† 3. 5.31. 4. two series of several short waves separated by an interval of ab. 5 secs. g. W. to E.
1616. *Rhosllanerchrugog*.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 3. ab. 5.30. 4. 3 or 4 rather prolonged jerks, the first one the most pronounced.
1617. *Ruabon*.—Mrs. Eyton-Jones.† 3. ab. 5.30. 4. two series of vibra., with ab. 6 secs. bet. d. yes. 6. 5. 7. thunder. d. yes.
1618. *Ruthin*.—Rev. B. O. Jones. 3. 5.30. 5. ab. 2 secs. 6. 5? 7. a rumbling heard both before and after the sh.
1619. *Trefnant*.—Mr. F. Rees. 4. a severe sh. g. S. to N.
1620. *Wrezham*.—Mr. W. Rogers. 3. 5.35. 4. b. 4 vibra. c. yes. g. S. to N. 6. 5. 7. rolling thunder. b. p. ab. 3 secs.
1621. Do.—(*Montgomery County Times*, Welshpool, Dec. 19.) 3. 5.32. 6. 5.
1622. Do.—(*Standard*, Dec. 18.) 6. 5. 7. the sh. acc. by grating, roaring noises.

MONTGOMERYSHIRE

1623. *Abermule*.—Mr. T. Frylor† (c. by Mr. C. S. Dennis). 3. 5.32 A.M. 4. trem. mot. 7. a train passing.

1624. *Afonwen*.—(*Denbighshire Free Press*, Denbigh, Dec. 19.) 3. ab. 5.45. 6. 5. 7. a rumbling noise, as of distant thunder. b. p.
1625. *Berriew*.—(*Montgomery County Times*, Welshpool, Dec. 19.) 6. 7?
1626. *Caerswa*.—Rev. O. Williams* (c. by Mr. R. Snow). 3. 5.34. 4. 5 or 6 horizontal vibra, lasting ab. $1\frac{1}{2}$ secs., f. by a trem. mot. for ab. 1 sec., wh. seemed more intense. f. no. 5. ab. $2\frac{1}{2}$ secs. 6. 5. 7. no so. heard until the sh. was dying away, and there was then a very low noise, something like that of a train crossing a distant wooden bridge; it only lasted a very short time.
1627. *Cemmaes*.—Mr. J. Bradwell.* 3. 5.30. 4. the bed rocked. 5. ab. 5 secs. 6. 5. 7. a rush of water, as of a waterfall. b. p.
1628. Do.—(c. by Mr. Y. M. Jones-Humphreys) 3. 5.30. 4. d. yes. 6. 5. 7. the eq. began with a rumbling as of underground thunder.
1629. *Cemmaes Road*.—Miss H. E. Jones. 3. 5.30. 4. d. yes. e. mid. 5. ab. 60 secs. 6. 5. 7. a heavily-laden waggon going over stones. b. p. c. c. d. yes. e. p. f. yes.
1630. Do.—Mr. T. H. Penrose* (c. by Mr. C. S. Dennis). 3. ab. 5.30. 4. one series. d. yes. e. mid. 5. ab. 5 secs. 6. 4. 7. thunder. d. yes. e. c.
1631. *Garthbeibio*.—Rev. J. R. Roberts† 4. d. yes. 6. pr. 5. 7. a dull roaring so. like that of a chimney on fire. d. yes.
1632. *Garthmyl*.—(*Montgomery County Times*, Welshpool, Dec. 19.) 6. 7?
1633. *Gwilsfield*.—Rev. J. S. Lewis† 3. bet. 5.30 and 5.40. 6. 5. 7. a heavy train passing. b. p. c. f. a few secs. d. died away quickly.
1634. *Llanbrynmair*.—Mr. R. Howell* (a. by Mr. C. S. Dennis). 3. ab. 5.30. 5. 2 secs. 6. 4. 7. no.
1635. Do.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 4. sh. felt. 7. the sh. was acc. by a low rumbling so., as of "bones falling pell-mell, but with a deeper so."
1636. *Llandinam*.—Mr. J. Woosnam* (c. by Mr. C. S. Dennis). 3. 5.32. 4. a. yes, 6 or 7 secs. b. 2 prin. vibra. ab. 4 secs. c. yes, ab. 2 secs. d. yes. e. mid. f. yes. 5. 10 or 12 secs. 6. 5. 7. a heavy mineral train passing at a short distance. b. p. 6 or 7 secs. c. c. nearly. d. yes. e. p. 2 secs. f. yes.
1637. Do.—Mr. W. Woosnam.* 3. ab. 5.15. 4. as if something heavy came in contact with the bed-posts, then there were 3 distinct heaves, as if some one were under the bed. 6. 5. 7. so. heard.
1638. *Llandrindod*.—Anon.* (c. by Mr. A. Stone). 3. 5.40. 4. the bed suddenly began to rock and sway, as though some one underneath lifted it bodily; 6 or 7 distinct waves. 6. 4 5. 7. the obs. fancied there was a slight rumbling.
1639. *Llandrinio*.—Rev. D. R. Thomas† 6. 5.
1640. *Llanerfyl*.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 5. 10 secs. 6. 4.
1641. *Llanfair*.—(*Montgomery County Times*, Welshpool, Dec. 19.) 3. ab. 4.50. 5. several secs. 6. 4.
1642. *Llanfechain*.—Miss M. Davies* (c. by Mr. C. S. Dennis). 3. 5.30. 4. the kind of slight shaking that a heavy train coming into the

station would cause. 5. ab. 12 secs. 6. < 4. 7. a heavy train coming into the station.

1643. *Llanfyllin*.—Mr. F. Felix Jones† 3. 5.30. 4. 3 waves. d. yea. e. mid. f. no. 5. ab. 5 secs. 6. 7? 7. no, but (according to other observers) a so. like the rumbling of thunder p. the sh.

1644. *Llangurig*.—Rev. T. H. Hughes† 3. bet 5 and 6. 4. the sensation was as though a heavy cartload of coals was being tipped. 5. a few secs. 6. 4.

1645. Do.—(*Onwestry and Border Counties Advertiser*, Dec. 23.) 6. pieces of earthenware were thrown down and broken, beds were felt to rock to and fro.

1646. *Llangynog*.—(c. by Rev. O. Jones) 3. ab. 5.30 or a little later. 4. the movement grad. incr. in int. 7. a rumbling so., ending in a kind of moan, p. the sh.

1647. *Llanidloes*.—Rev. E. O. Jones 3. ab. 5.30. 4. several vibra., apparently of the same int. throughout. 6. pr. 6. 7. the whizzing of large winds (another obs., just waking, thought a heavy waggon was coming up the drive); the so. stopped suddenly, and was quite over well before the vibra. began.

1648. Do.—Mr. H. Dulston† (c. by Mr. C. S. Dennis). 3. bet 5.30 and 5.35. 4. a. yea, 3 to 5 secs. b. pr. a dozen, ab. 3 secs. 6. 5. 7. like a goods-train coming into the station and running on hard frosty ground, and ending like dead buffer waggons bumping when pulled up by a steam brake; the so. travelled northward. b. p. ab. 2 or 3 secs. e. p. > 1 sec.

1649. Do.—(*Montgomeryshire Echo*, Llanidloes, Dec. 19.) 3. ab. 5.30. 4. several shs. following one another in quick succession. 6. < 5. 7. the shs. were acc. by a loud rumbling noise, as if large masses of snow were thrown off high roofs to the ground.

1650. *Llanllugan*.—Rev. C. Williams 6. the churchyard wall, wh. was in a dilapidated state, was extensively damaged on the morning of Dec. 17.

1651. *Llansaintfraid*.—(c. by Rev. T. H. Lloyd.) 3. 5.30. 4. the bed shook and rose. 6. 5.

1652. Do.—A. Lewis† 3. ab. 5.30. 4. many vibra. f. yea. g. also a horizontal movement, N. to S. 6. 5? 7. distant thunder or a passing train. b. c. c. c. d. yea.

1653. *Machynlleth*.—Mr. T. Clayton† (c. by Rev. T. W. Trevor). 3. 5.30. 4. two motions, the second more violent; the house seemed to sway more than 2 in. 6. 5. [the house is built on very soft ground, clayey rather than peaty.]

1654. Do.—Mr. A. Harris* (c. by Rev. T. W. Trevor). 3. 5.30. 4. g. S.E. to N.W. 5. ab. 30 secs. 6. 5? 7. no.

1655. Do.—Mr. W. E. Evans† (c. by Rev. T. W. Trevor). 3. ab. 5.30. 5. 4 or 5 secs. 7. no.

1656. Do.—Mr. J. Morris* (c. by Rev. T. W. Trevor). 3. ab. 5.30. 5. a few secs. 6. 5?

1657. Do.—(*Montgomeryshire Echo*, Llanidloes, Dec. 19.) 3. ab. 5.35. 5. ab. 3 secs. 6. 5. 7. "the eq. was sharp and loud."

1658. *Maesbrook*.—Mr. T. Davies (c. by Mr. C. S. Dennis). 6. a crack was made in a house, and plates were shaken from the racks.

1659. *Meifod*.—Mr. M. D. Morris* (c. by Mr. A. George). 3. 5.32. 4. like the rocking of a cradle; only one series. 5. 3 secs. 6. 7? 7. a so. like rats in the ceiling p. the rocking; at the end of the sh. there was a rumbling so. like distant thunder.

1660. Do.—Mr. R. R. Lewis* (c. by Mr. J. S. Greene). 3. ab. 5.35. 4. a rolling sensation. 5. ab. 20 secs. 6. 5. 7. d. yes. e. f. almost imm. f. slightly.

1661. Do.—Mrs. L. M. Luxmoore. 3. 5.30. 4. the sh. in two distinct parts, first rocking and then trembling. 6. 6. 7. a rumbling so. heard by others.

1662. *Mellington*.—Mr. P. Wright† 3. ab. 5.30. 4. the vibr. like that caused by a traction-engine passing down the street. 6. < 5. 7. no.

1663. *Montgomery*.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 4. a succession of distinct shs. 6. < 4. 7. the sh. was acc. by a rumbling so.

1664. *Newtown*.—Rev. E. A. Fishbourne† 3. ab. 5.32. 4. a violent shaking. f. no. 5. ab. 5 secs. 6. 5.

1665. Do.—Mr. W. Cooke.* 3. 5.32. 4. a rising, acc. or imm. f. by a violent shaking, of the bed; f. in 1 or 2 secs. by another sh. stronger than the first. g. S.E. to N.W. 5. > $\frac{1}{2}$ min. 6. 5. 7. a noise like an explosion f. in 1 or 2 secs. by a rising of the bed; the sh. passed away with a noise like the fluttering of a large bird.

1666. Do.—(*Montgomery County Times*, Welshpool, Dec. 19.) 3. ab. 5.30. 5. ab. 10 or 15 secs. 6. 5.

1667. Do.—(*Daily News*, Dec. 18.) 6. 7?

1668. *Penybontfawr*.—Mr. J. E. Jackson† 3. 5.30. 4. b. 3 vibra. 5. ab. 3 secs. 6. 5. 7. a heavy waggon coming down a hill. d. yes.

1669. *Scafell Station*.—Mrs. Jarman. 3. 5.10. 4. d. yes. e. mid. 6. 5.

1670. *Trefeghoya*.—Rev. E. Edwards.* 3. bet. 5.30 and 5.35. 4. g. W. to E. 5. 5 or 6 secs. 6. < 4, in one house a book fell from the shelf. 7. a noise, like that of a distant hooter, wh. lasted ab. 4 or 5 secs.; in ab. 6 secs. it was f. by a trembling so. and a violent shaking, wh. lasted ab. 5 or 6 secs. and decr. grad.

1671. *Tregynon*.—(*Montgomery County Times*, Welshpool, Dec. 19.) 3. ab. 5.30. 6. 5. 7. the sh. was p. by a low rumbling so.

1672. *Trewern*.—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 3. bet. 5 and 6. 4. 2 or 3 shs. 5. 4 or 5 secs. 6. < 5, in some houses plates and dishes were thrown off the shelves.

1673. *Tylwch*.—Mr. J. Pryce (c. by Mr. C. S. Dennis). 3. 5.35. 5. ab. 10 secs. 6. 4. 7. no.

1674. *Welshpool*.—(*Montgomery County Times*, Welshpool, Dec. 19.) 3. 5.40. 6. < 5. 7. noise heard in several cases.

1675. Do.—(*Shrewsbury Chronicle*, Dec. 18.) 3. bet. 5.30 and 5.40. 5. several secs. 6. 5.

GLAMORGAN

1676. *Aberavon*.—Rev. H. Morris† 3. ab. 5.30 A.M. 4. 2 prin. vibra.,

with a few secs. intervening. 6. pr. 5. 7. the so. f. the sh. was loud, and then decreased.

1677. Do.—(*S. Wales Daily News*, Cardiff, Dec. 18.) 3. ab. 5.30. 5. ab. 10 secs. 6. pr. 5.

1678. *Aberdare*.—(c. by Mr. W. O'Connor, F.G.S.) 3. 5.40. 5. ab. 6 secs. 6. 5. 7. a locomotive passing in front of the house at a good speed.

1679. Do.—Mrs. W. Thomas † (c. by Mr. D. J. A. Rees). 3. ab. 5.30. 5. ab. 5 secs.

1680. *Ash Hall*.—Mr. Tudor Owen * (*Western Mail*, Cardiff, Dec. 18). 3. a few secs. before 5.35. 6. 5.

1681. *Bedlinog*.—Mr. T. C. Thomas. 3. 5.30. 4. one continuous trem. mot. 5. ab. 3 secs. 6. 5. 7. the sh. was acc. by a slight rumbling so like that of a passing gust of wind. c. f. ab. 2 secs.

1682. *Bridgend*.—Mr. T. G. Smith. 3. 5.30. 4. the bed shook horizontally and seemed to shiver. 5. 3 secs. 6. 5. 7. no.

1683. Do.—(*Western Mail*, Cardiff, Dec. 18.) 3. ab. 5.30. 6. 5.

1684. *Caerphilly*.—(c. by Mr. Gavin H. Jack, F.G.S.) 3. ab. 5.30. 4. a. yes, a fraction of a sec. b. \leftarrow 6 vibra. c. no. d. yes. e. mid. f. no. 5. ab. 3 secs. 6. \leftarrow 4. 7. no.

1685. Do.—(*S. Wales Daily News*, Cardiff, Dec. 18.) 3. ab. 5.30. 4. g. S. to N. 6. \leftarrow 5. 7. the vibr. was acc. by a rumbling so.

1686. *Cardiff*.—Mr. A. Mee, F.R.A.S.† 3. 5.32. 4. a sharp vibratory movement, as though a traction-engine were passing. 5. ab. 10 secs. 6. \leftarrow 4. 7. no.

1687. Do.—S. M. Price.† 3. 5.30½. 4. the sh. swayed a heavy wardrobe and then rocked the bed 2 or 3 times. f. yes. 5. ab. 5 secs. 6. 5.

1688. Do.—Mr. W. H. Banner.* 3. ab. 5.32. 4. the movement began with several vibra., wh. grad. died away; an upward movement first felt, then a sort of rolling movement. 6. 5. 7. a heavy train passing. b. c. c. p.

1689. Do.—Mr. W. Hart.† 3. ab. 5.30. 4. awakened by doors and windows vibrating, then the bed heaved up on one side 3 times in succession. g. N. to S. 5. ab. 15 secs. 6. 5.

1690. Do.—Mr. S. Shedden.† 3. 5.34½. 4. a rolling motion f. by trem. mot. 5. 2 to 5 secs. 6. 5. 7. no.

1691. Do.—Mr. Spiridion (*S. Wales Daily News*, Cardiff, Dec. 18). 3. 5.40. 4. 3 series of 4 vibra. each, the interval bet. the first two series being 3 secs., the last series the strongest. 5. 15 to 20 secs. 6. "I carefully examined all the pictures on the walls of my house this morning, and I find only that two miniatures suspended by a brass ring on a fine nail are out of the perpendicular, and these are on a wall running from S.E. to N.W."

1692. Do.—Ald. Sanders * (*S. Wales Daily News*, Cardiff, Dec. 18). 3. ab. 5.30. 6. \leftarrow 4. 7. a strange deep sort of groan.

1693. Do.—Mr. E. Parker (*S. Wales Daily News*, Cardiff, Dec. 18). 6. 5.

1694. Do.—Mr. U. Rogers (*Western Mail*, Cardiff, Dec. 18). 4. g. W. to E. 6. \leftarrow 4.

1695. Do.—Mr. J. R. Winn * (Do.). 3. just after 5.30. 5. ab. 20 secs. 6. 5.

1696. Do.—(Do.) 3. 5.30. 6. 5. 7. the depositing of a ton weight of goods on the landing outside.

1697. *Dinas Powis*.—Mr. N. Lattey (*Western Mail*, Cardiff, Dec. 18). 4. 2 shs. 6. 5.

1698. *Dowlais*.—Mr. T. F. Price † (c. by Mr. J. Galt). 3. 5.30. 5. ab. 5 or 6 secs. 6. < 4. 7. a low rumbling so. f. the sh.

1699. *Dowlais Top Station*.—Mr. T. L. Davies (c. by Mr. J. Galt). 3. ab. 5.30. 5. ab. 2 secs. 6. < 4.

1700. *Fonmon*.—Mr. G. Hancock * (c. by Mr. O. H. Jones). 3. ab. 5.30. 6. 5.

1701. *Garth Hill*.—Mr. J. L. Wheatley † (*Western Mail*, Cardiff, Dec. 18). 3. ab. 5. 4. 2 series of vibra. 7. a rumbling noise, as of a heavily-laden waggon, p. each series.

1702. *Glyn Neath*.—Mr. A. E. Elcock (c. by Rev. J. L. Thomas). 3. 5.33. 4. a. yes, ab. 30 secs. b. one series of prin. vibra., ab. 20 secs. c. yes, a little over 30 secs. d. yes. e. mid. f. yes. 6. 5. 7. the passing of a heavy train; the so. continued during the vibr. d. yes. e. c. f. thunder at a distance.

1703. *Hirwain*.—Mr. J. W. Morgan.* 3. 5.35. 4. a. no. b. 3 sharp vibra. [series?], the two first most intense in rapid succession, the last vibr. lasting quite 8 secs. e. beg. g. W. to E. 5. ab. 12 secs. 6. 5. 7. the discharge of heavy artillery. b. c.

1704. *Kenfig Hall*.—(*Western Mail*, Cardiff, Dec. 18.) 3. ab. 5.30. 5. ab. 6. secs. 6. 6?

1705. *Llandaff*.—Mr. T. H. Bailey.* 3. 5.30. 4. 2 prominent vibra., ab. 2 secs. each, trem. mot. bet. them. e. beg. and end. f. no. 5. ab. 7 or 8 secs. [so that interval must have been ab. 3 or 4 secs.] 6. 4. 7. no.

1706. Do.—Mr. T. C. Thomas (*Western Mail*, Cardiff, Dec. 18). 3. 5.35. 6. 5. 7. just as the oscillation was about to cease, a deep so., resembling a heavy dull thud, was heard.

1707. Do.—Mr. Ashby* (*S. Wales Daily News*, Cardiff, Dec. 18). 3. 5.38. 5. ab. 7 secs. 6. < 4. 7. the sh. acc. by a rumbling so.

1708. Do.—Mr. W. Reece (Do.). 4. the tremor like that caused by a very heavy waggon passing. 5. ab. 12 or 15 secs. 6. 5. 7. a heavy rumbling so. acc. the sh.

1709. *Llandow*.—(c. by Rev. W. J. Edwards.) 3. from 5 to 5.30. 4. sh. felt. 7. the sh. acc. for some time by a rumbling noise.

1710. *Llangynwyd*.—Rev. S. Jackson. 3. 5.34. 4. one series of vibra., without any perceptible change of int. f. no. 5. 3 or 4 secs. 6. < 4. 7. no.

1711. *Llanilid*.—Anon.* (c. by Rev. J. Morgan). 3. bet. 5 and 5.30. 4. the bed swayed from side to side. 5. not many secs. 6. 5. 7. the mutter of thunder.

1712. *Llantwit Vardre*.—Mr. W. T. O. Jones* 3. ab. 5.35. 4. the vibra. commenced softly and incr., then dim. a little and incr. until it became stronger than at first. f. yes. g. W. to E. 5. 40 to 45 secs. 6. 5.

1713. Do.—Mr. T. C. S. Brendon. 3. 5.30. 4. a. no. b. 3 vibra., ab. 5 secs. c. yes, ab. 5 secs. f. no. 5. ab. 10 secs. 6. 5. 7. no.

1714. *Llanvabon*.—N. Leigh. 3. ab. 5.30. 5. 10 or 15 secs. 6. 5.

7. a heavy waggon passing; the so. p. the sh., lasting 10 or 15 secs., it became grad. louder and then died away.

1715. *Loughor*.—(c. by Rev. D. T. Jones). 3. bet. 5.20 and 5.30. 5. a few secs. 7. so. heard.

1716. *Marcross*.—Rev. P. W. Jones† 5. ab. 3 secs. 6. 5.

1717. *Merthyr Tydvil*.—Mr. C. Williams, F.G.S. 3. 5.20. 4. 2 distinct sha., the first stronger, the interval bet. 1 or 2 secs. 5. ab. 3 secs. 6. 5. 7. a subterranean thunder-roll. b. p. imm.

1718. *Do*.—(*Western Mail*, Cardiff, Dec. 18.) 3. 5.30. 5. 8 to 10 secs. 6. < 5; at the Great Western Railway Station, the stationary carriages were observed to oscillate and were almost set going along the line.

1719. *Morriston*.—(Do.) 6. 5.

1720. *Mountain Ash*.—Mr. M. Morgan* 3. 5.35. 4. trem. mot. only, of the same int. throughout. f. no. 5. ab. 10 secs. 6. < 4. 7. at first as if a strong wind were pressing against the door, changing into a peculiar moaning so., and dying away with the vibra.

1721. *Mumbles*.—Mr. A. Paton* (*Herald of Wales*, Swansea, Dec. 19). 3. ab. 5.30. 5. several secs. 6. pr. 5.

1722. *Nantymoel*.—Mr. H. Job.* 3. ab. 5.35. 4. a. yes. b. one series, 5 or 6 secs. c. no. d. yes. e. mid. 6. pr. 5. 7. a rumbling so. b. c. c. c.

1723. *Neath*.—Mr. H. T. Harries* 3. 5.33.* 4. a. yes, ab. 4 secs. b. one series, ab. 8 secs. c. yes, ab. 8 secs. d. yes. f. yes. g. S.E. to N.W. 5. ab. 20 secs. 6. 5. 7. somewhat resembling a hurricane; the so. seemed uniformly loud, beginning at the moment the sh. reached its greatest int. and lasting perhaps 4 or 5 secs. after the sh. had entirely ceased.

1724. *Do*.—(*S. Wales Daily News*, Cardiff, Dec. 18.) 7. the sh. was acc. by a rumbling noise like that produced by the movement of heavy ordnance.

1725. *Newton*.—Rev. S. Jones† 3. ab. 5.40. 4. a general tremble. 5. bet. 1 and 2 secs. 7. a so., as of a train passing, heard by other observers.

1726. *Penarth*.—Mr. G. G. Pike† 3. 5.40. 4. only one sh., not a rocking, but a severe trembling. 5. ab. 10 secs. 7. a heavy, harsh, low, grating so., like that of vast masses of rock falling from a great height and crushing against each other in their descent, only much deeper; the so. was heard first ab. 4 secs. before the sh. and throughout the same. c. c.

1727. *Do*.—Mr. J. Weaver* (*Western Mail*, Cardiff, Dec. 18). 4. the bed trembled. 7. no.

1728. *Pencoed*.—Mr. A. Smith. 3. 5.35. 4. a. no. b. 3 prin. vibrs., 4 secs. c. yes, ab. 1 sec. 6. pr. 6. 7. a train passing. b. p. ab. 1 sec. d. yes. f. no.

1729. *Pendoylan*.—Rev. T. H. Lewis† 3. 5.30. 4. 2 series of vibrs. 7. a so. was heard with the first series.

1730. *Penllergaer*.—Sir J. T. D. Llewellyn, Bart.† 3. 5.35. 4. g. S.E. to N.W. 5. 1 or 2 secs. 6. 5. 7. no.

1731. *Penmaen*.—Miss M. Bowen† (c. by Miss E. A. Bostock). 3. ab. 5.35. 6. 6? 7. a rumbling and hissing so. f. the sh.

1732. *Pentre*.—Mr. W. O'Connor, F.G.S. 3. 5.31 or 5.32. 4. the vibra of nearly equal strength. 5. 6 secs. 6. 5. 7. a heavy dray going over a newly macadamised road. b. c. ab. c. c. ab.

1733. *Peterston-super-Ely*.—Mr. C. Waring* (*Western Mail*, Cardiff, Dec. 18.) 3. 5.35. 5. ab. 10 secs. 6. 5.

1734. *Pontlloftyn*.—Mr. J. Powell † (c. by Mr. J. Galt). 3. ab. 5.30. 4. the bed was shaken regularly and violently in a horizontal direction. 5. ab. 8 secs. 6. 5. 7. no.

1735. *Pontypridd*.—Mr. J. B. Harria† 3. 5.33. 4. b. 3 vibra, ab. 10 secs. c. yes, ab. 8 secs. d. little, if any, difference in int. 6. < 5.

1736. *Do*.—Mr. F. R. Williams† 3. 5.30. 4. a tremulous shaking of the bed. 5. ab. 4 secs. 6. 5. 7. no.

1737. *Do*.—(*S. Wales Daily News*, Cardiff, Dec. 18.) 3. 5.30. 4. 3 distinct and severe shs. 6. 5.

1738. *Do*.—(Do.) 3. 5.36. 6. pr. 6.

1739. *Porthcawl*.—Anon. 3. 5.22. 4. a. yes, ab. 2 secs. b. one series, ab. 4 secs. c. yes, ab. 3 secs. d. yes. e. mid. 6. a chimney of a house situated on the New Road was cracked. 7. a heavy cart passing. b. f. c. c. d. yes. e. c.

1740. *Do*.—Mr. T. Cook (c. by Mr. C. Dalby). 3. 5.25. 4. b. 2 vibra. of ab. the same duration. c. gradual settling down, ab. 10 secs. e. beg. g. E. to W. 6. 5. 7. a rumbling so., as if a heavy waggon were passing, p. the sh. ab. 6 secs. [the so. apparently ended as the sh. began].

1741. *Do*.—(*S. Wales Daily News*, Cardiff, Dec. 18.) 3. ab. 5.20. 5. a few secs. 6. pr. 6.

1742. *Porthkerry*.—(c. by Rev. Canon E. E. Allen.) 3. 5.40. 4. sh. felt.

1743. *Pyle*.—Mr. J. Felton, jun.* 3. ab. 5.37. 4. one sh. grad. increasing, dying away slightly, increasing again, and then dying away altogether; a smooth quick shaking, ab. 5 vibra. to a second. 5. ab. 7 secs. 6. 5. 7. no, but two other obs. (who were both awake) heard a noise as of a passing gust of wind, coming from the N. and dying away to the S. b. f. 1 or 2 secs.

1744. *St. Bride's Major*.—Anon* (c. by Rev. T. Jones). 3. ab. 6. 6. < 4. 7. a rumbling noise, wh. lasted a few secs.

1745. *St. Fagans*.—Mr. E. U. David † (c. by Rev. W. David). 3. 5.30. 4. the bed rose, and then seemed to move ab. an inch towards the W. and back again. c. yes. 5. ab. 10 secs. 6. 5. 7. the so. only lasted a few secs. after the obs. awoke.

1746. *St. Nicholas*.—E. G. Bruce.* 3. ab. 5.35. 4. two distinct vibra. from N. to S., such as might be made by a heavy cart passing. 5. a very few secs. 6. 4? 7. a so. like a distant explosion in the N., f. by two distinct rumbling vibra.

1747. *Sketty*.—(*Herald of Wales*, Swansea, Dec. 19.) 3. ab. 5.30. 4. the house distinctly shook. 7. a rumbling noise.

1748. *Swansea*.—Mr. T. Robinson.† 4. a vibr. like that caused by the rolling of a goods-train. 6. < 4. 7. a heavy vehicle passing.

1749. *Do*.—Mr. D. J. A. Rees. 3. 5.40. 6. 5?

1750. *Do*.—Mr. H. Watkins † (*S. Wales Daily News*, Cardiff, Dec. 18, and

Herald of Wales, Swansea, Dec. 19). 3. 5.36. 4. two series, the first stronger: the first sh. consisted of an upheaval of the house and then it subsided quietly and gently; very soon after came the second sh., more gentle than the first, merely a shaking to and fro without any upheaval, and, looking at the wall, the obs. saw it wave to and fro. 6. 5. 7. an extraordinary noise.

1751. Do.—Mr. W. Watkins, J.P.* (*Herald of Wales*, Swansea, Dec. 19). 3. ab. 5.25. 4. as if a steam-roller were passing along the street. 5. 2 or 3 secs.

1752. *Tongwynlais*.—(*Western Mail*, Cardiff, Dec. 18.) 6. pr. 5.

1753. *West Cross*.—Miss M. Bassett.* 3. 5.30. 4. a wavy lateral movement of the bed, f. soon after by a trembling kind of sh. 6. 5. 7. no.

1754. *Ystrad Rhondda*.—(*S. Wales Daily News*, Cardiff, Dec. 18.) 3. 5.30. 4. a wave-like motion. 5. ab. 10 secs. 6. 5.

CORNWALL

1755. *Bosvathick*.—Mr. G. Fugler. 3. ab. 5.30 A.M. 4. a slight vibr. 6. 4. 7. distant thunder.

1756. *Launceston*.—(*Western Weekly Mercury*, Plymouth, Dec. 19.) 4. sh. distinctly felt.

1757. *Liskeard*.—(Do.). 4. sh. distinctly felt. 7. in one or two cases a distant rumbling so. was heard.

1758. *Lostwithiel*.—Mr. J. J. Pease (*Western Morning News*, Plymouth, Dec. 19). 4. a distinct sh. 5. ab. 15 secs. 6. pr. 4.

1759. *Penzance*.—Mrs. Vigurs.* 3. bet. 5.15 and 5.30. 6. 4 or 5, pr. 4.

1760. Do.—Anon.† (c. by Rev. T. P. Moreton). 3. bet. 5.30 and 5.40. 4. the bed shook. 7. no.

1761. *Trevone*.—Mrs. Miller.* 3. ab. 5.30. 6. 4.

DEVON

1762. *Annery*.—Mr. H. Santon.† 3. bet. 5 and 6 A.M. 4. the bed shook as if a heavy luggage-train had passed near the house. 5. ab. a min. 6. < 4.

1763. *Arlington*.—Lady Chichester. 3. 5.40. 4. the bed felt as if heaved up and then the whole house trembled. 5. ab. 30 secs. 6. 5; some whips on a bracket on a bedroom wall fell off. 7. like the rushing of wind to some observers, to others like the so. of heavy waggons passing; if anything, the so. p. the upheaval, but all was quiet during the trembling.

1764. *Azminster*.—Mrs. A. P. Rogers.† 3. 5.35. 5. ab. 60 secs. 6. 5. 7. no.

1765. Do.—(*Pulman's Weekly News*, Yeovil, Dec. 24.) 3. 5.33. 6. 5.

1766. Do.—(*Somerset County Herald*, Taunton, Dec. 19.) 6. < 4. 7. a low rumbling so.

1767. *Azmouth*.—Mr. B. J. M. Donne. 3. ab. 5.30. 4. like 3 bumps or heavy footfalls, increasing in int. 6. < 4.

1768. *Bampton*.—Miss L. A. Dart.* 3. 5.33. 4. a rapid vibratory motion; the sh. consisted of two parts separated by an interval of ab. 5 secs., the second part stronger. 5. 20 to 30 secs. 6. 5. 7. a very heavy vehicle passing; the so. c. with the sh.

1769. Do.—Rev. H. F. Holmes. 3. ab. 5.30. 4. an undulating motion. g. W. to E. 7. a sort of hissing, windy so.

1770. *Barnstaple*.—Mr. A. C. King.* 3. 5.34. 4. there was one sh. proper, and, after an interval of ab. 15 secs., a very slight trembling occurred. g. W.N.W. to E.S.E. 5. fully 10 secs. [the first part]. 6. 5; the glass doors of a bookcase (facing due W.) were thrown open. 7. no.

1771. Do.—Mr. H. J. Knott.* 3. 5.29. 4. only one sh. 5. ab. 10 or 15 secs. 6. < 4. 7. a large empty waggon going over a rough road. b. p. 1 or 2 secs. c. c.

1772. *Bere Alston*.—Mr. C. W. Croft* (*Western Morning News*, Plymouth, Dec. 19). 3. ab. 5.30. 4. the room shook as though some one had walked heavily across the floor. 6. pr. 5.

1773. *Bideford*.—Mr. W. Squibb.* 3. 5.33. 4. a. a slight vibr. for a sec. b. f. by an upheaval, the tower [of the Bideford Bar Lighthouse] appearing to rise and fall, rather than vibrate, for ab. 7 secs. c. no. d. yes. e. mid. 6. 5. 7. a very loud rumbling like that of a heavy waggon passing over the paving. b. p. ab. 1 sec. c. c. d. yes. e. c. ab. f. no.

1774. Do.—Mr. F. A. Trevan. 3. 5.33. 4. a continuous trem. vibr. 5. 20 to 30 secs. 6. 5.

1775. Do.—Rev. G. Bennett.† 4. a rolling and heaving movement, quicker than that of a boat. g. N. and S. 5. ab. 7 secs. 6. 5.

1776. Do.—Miss Cadd. 3. 5.35. 4. the bed moved up and down. 6. 5. 7. a traction-engine passing.

1777. Do.—I. A. Bowles. 3. bet. 5.30 and 5.45. 4. a distinct tremor. 6. < 4. 7. a rumbling so. like that of a traction-engine passing, f. by the tremor.

1778. *Bow Station*.—Mr. A. N. Webb. 3. 5.32. 4. an undulating vibr. 5. 2 or 3 secs. 7. no.

1779. *Buckland*.—Mr. W. E. P. Bastard.† 6. 5? 7. a dull rumble something like a switchback railway passing; the so. rose and fell quite regularly.

1780. *Budleigh Salterton*.—Mr. E. L. Layard.* 3. 5.31. 4. 3 distinct triple [semi-] vibra. g. W. to E.

1781. *Chagford*.—Mr. C. Hayter-Hames.† 3. 5.35. 5. 15 to 30 secs. 6. 5. 7. a great rumbling. b. p. ab. 15 secs.

1782. *Chudleigh*.—Anon.† (c. by Mr. R. Long). 3. ab. 5. 4. the bed swayed to and fro as though in a ship at sea. 6. 5.

1783. Do.—S. E. Whiteway.* 3. ab. 5.40. 4. two series, separated by a very brief interval. 7. no.

1784. *Churchstanton*.—Rev. A. D. Taylor. 3. 5.34. 4. a horizontal vibr.; two shs, interval bet. them ab. 30 secs, the first by far the stronger. 5. ab. 8 or 9 secs. 6. 4. 7. no.

1785. *Colyton*.—Anon.† (c. by Mrs. Sharland). 3. 5.30. 6. 5?

1786. *Cornwood*.—Anon.* (*Western Weekly Mercury*, Plymouth, Dec. 19). 3. ab. 5.30. 4. sh. felt.

1787. *Crediton*.—(*Western Morning News*, Plymouth, Dec. 18.) 3. bet. 5.30 and 6. 6. a slight sh.

1788. *Cullompton*.—Rev. G. Forrester.† 4. a decided trem. or swaying motion; there seemed to be a succession of some 4 or 5 series of vibra, beginning slightly, increasing, and grad. dying down. e. beg. 6. pr. 5. 7. a rumbling noise. d. yes.

1789. *Devonport*.—Prof. A. M. Worthington, F.R.S.† 3. 5.33. 4. only one series felt. 5. ab. 3 secs. 7. the sh. was acc. by a rolling rumbling noise as of a railway-train or heavy ammunition-waggons passing.

1790. *Exeter*.—C. Fursdon.* 3. 5.35. 4. a. yes, ab. 7 secs. b. two prin. vibra (very marked), ab. 10 secs. c. yes, like a shiver. d. grad. incr. to the two prin. vibra. f. no. g. W. to E. (both sh. and so.). 6. 5. 7. the sh. was p. and acc. by a loud hissing rushing so. b. p. c. c. d. became grad. louder. e. c. f. no.

1791. Do.—A. W. Fursdon† (c. by C. Fursdon). 3. 5.35. 4. one continuous vibr. d. yes. f. no. 6. 4. 7. a loud underground train or a heavily loaded waggon, the so. p. and acc. the sh. d. yes.

1792. Do.—Mrs. Pattison. 3. 5.35. 4. 4 trem. motions or sha. 5. 10 secs. 6. 5. 7. a heavy train passing; the beg. of the so. imm. f. the end of the sh.

1793. Do.—A. Ware.† 3. ab. 5.30. 4. bed heaved 7 times. 6. pr. 5. 7. a rumbling noise.

1794. Do.—Mr. W. J. Stone.* 3. 5.30. 4. a jerk from the N.W. side, f. by trem. mot. 5. fully 10 secs. 6. pr. 5. 7. a distinct rumbling so. like that of a soft roll of a big drum. b. f. 3 or 4 secs. c. f. 3 or 4 secs.

1795. Do.—Mrs. Jackson.* 3. 5.45. 4. a sudden tremor, wh. lasted ab. 2 secs.; after 2 or 3 secs. there was another and more severe shaking, lasting 4 or 5 secs. 6. < 4. 7. no.

1796. Do.—Mr. E. H. Shorto.* 3. 5.30. 4. 2 sha, the second a minute [*sic*] or two later. 6. 4.

1797. Do.—Miss B. Pasmore.† 3. 5.30. 6. 4. 7. a heavy rumbling.

1798. Do.—(c. by Mr. W. E. Bealey.) 3. 5.35. 4. the bed was rocked violently N. and S. 6. 5. 7. at the same time, a noise like that of a traction-engine passing.

1799. Do.—Mr. H. Moore. 3. ab. 5.36. 4. 2 distinct sha. or lurches that caused a slight rolling sensation. 5. ab. 5 secs. 6. no.

1800. Do.—(*Daily Telegraph*, Dec. 18.) 3. bet. 5.30 and 5.40. 6. 5. 7. the rolling of a traction-engine at a distance.

1801. Do.—(*Times*, Dec. 18.) 4. a comparatively slight sh. 7. the rumble of a distant traction-engine.

1802. *Exmouth*.—Mr. S. Pimm. 3. ab. 5.25. 4. one continuous sh., as if some one at the head of the bed pushed it violently backwards, and forwards, slightly lifting the head part. g. W. to E. 5. 10 to 15 secs. 6. 5. 7. a heavy rumbling noise, like that of a steam-roller, p. the sh.

1803. Do.—Mr. J. M. Wadmore. 3. 5.34. 4. 4 sha. quickly succeeding one another, each beginning gently, grad. increasing to a max., and then

completely dying away again. *f.* no. *g.* S.E. to N.W. 5. ab. 20 secs. 6. 5. 7. no.

1804. Do.—Lt.-Col. R. H. S. Baker.† 5. ab. 10 secs. 6. 5. 7. a so. like that of a distant train, *p.* and almost *c.* with the sh.

1805. *Hartland*.—Rev. J. T. Giles. 3. ab. 5.40. 4. only one series. 5. 1 or 2 secs. 6. < 4. 7. no.

1806. *Hatherleigh*.—Mr. H. M. Darch. 3. 5.30. 4. one sh. 5. ab. 7 secs. 6. 5. 7. no.

1807. Do.—(*Western Morning News*, Plymouth, Dec. 18.) 4, 7. two distinct shs. felt and heard.

1808. *Heavitree*.—Mr. A. Wallis. 3. 5.36. 4. lateral vibrs, swaying the house, rapid, uniform and apparently continuous. *g.* N.W. to S.E. 5. ab. 10 secs. 6. 5. 7. a luggage-train passing through a tunnel, as heard from some distance. *b. c. c. c.*

1809. *Honiton*.—(*Western Morning News*, Plymouth, Dec. 18.) 6. 5.

1810. *Hooe*.—Mr. S. Andrews.* 3. ab. 5.30. 4. the vibrs. like those made by a person crossing the room. 5. ab. 3 or 4 secs. 6. 4. 7. a passing vehicle.

1811. *Horwood*.—K. T. Dluce. 3. 5.30. 4. one sh., the house shook as if something heavy had fallen. 5. ab. 7 secs. 6. 5? 7. no.

1812. *Ilfracombe*.—Mr. J. C. Clarke. 3. bet. 5 and 6. 5. ab. 5 to 10 secs. 7. like the so. heard in a quarry when rock is displaced; the so. was very distinct and came after the sh.

1813. *Ivybridge*.—Anon.* (*Western Weekly Mercury*, Plymouth, Dec. 19.) 3. ab. 5.30. 4. sh. felt.

1814. *Lynmouth*.—Mr. E. B. Jeune. 3. 5.34. 4. one sh., a quick undulating vibr. *g.* pr. N.E. to S.W. 5. 4 secs. 6. pr. 5. 7. no.

1815. *Manaton*.—Rev. J. C. B. Sanders. 3. 5.35. 4. one series. 6. 5? 7. no.

1816. *Plymouth*.—Miss F. S. Inship.† 3. ab. 5.30. 4. the bed seemed to rise ab. 4 ins., *f.* imm. by a trembling. 5. a few secs. 6. 5. 7. a muffled thud, something like a heavy mattress falling; the whole so. imm. *p.* the sh.

1817. *Post Bridge*.—Mr. H. C. Biddell. 3. 5.43. 4. one series. 5. ab. 6 secs. 6. < 4. 7. a deep booming noise like distant thunder. *b. p.* ab. 2 secs. *c. p.* ab. 5 secs.

1818. *Princetown*.—(*Western Morning News*, Plymouth, Dec. 18.) 3. 5.40. 5. 4 or 5 secs.

1819. *Seaton*.—C. L. Swinny.* 3. 5.40. 4. one series of vibrs. *f.* no. *g.* E. and W. 5. 15 secs. 6. 5? 7. the sh. was *p.* by a rushing noise ending in a "flump." *b. p.*, the sh. occurred simultaneously with the "flump." *c. p.*

1820. Do.—Miss F. P. Bundock.* 3. ab. 5.30. 4. two distinct parts, separated by a few secs., the second part much the stronger. 6. 4. 7. no.

1821. Do.—(*Somerset County Herald*, Taunton, Dec. 19.) 6. < 4. 7. a low rumbling so.

1822. *Shaldon*.—Miss E. Brown.† 6. 4. 7. a heavy rumbling so. like a traction-engine ab. 100 yds. off; the so. lasted 10 or 15 secs.

1823. *Sidmouth*.—Mrs. Gordon.† 3. 5.35. 4. a slight short rocking motion. 5. several secs. 6. 5.

1824. *South Brent*.—Mrs. Shettell. 3. 5.35. 5. ab. 3 secs. 6. 5? 7. a heavy luggage-train passing.

1825. *South Molton*.—Miss M. L. King.† 3. 5.27. 4. one uniform series of rather strong vibrs. f. no. g. E. to W. 5. ab. 30 secs. 6. pr. 5. 7. no.

1826. *Starcross*.—J. Seymour. 3. 5.35. 4. a severe rocking of the bed; two distinct shs, the second more severe. c. yea. g. E. to W. 6. < 5. 7. no, but another obs. was awakened by a noise like a traction-engine passing close by, and then felt the bed sway.

1827. *Stoke Rivers*.—Anon. 3. ab. 5.30. 4. two shs. in quick succession. f. yes. 6. 5. 7. imm. after the sh., a rushing so. like a gust of wind (but the air perfectly still).

1828. *Swymbridge*.—M. C. Shooter.* 3. 5.30. 4, 7. the effect was like that made by a heavy traction-engine going from S.W. to N.E.; the rumbling ceased and was f. by a rocking of the whole building and at the same time a noise like the collision of huge waves, making a loud hissing so.

1829. *Tavistock*.—(*Times*, Dec. 18.) 4. comparatively slight. 7. the rumble of a distant traction-engine.

1830. *Teignmouth*.—Anon. 3. bet. 5 and 6. 4. 3 vibrs. or waves. 6. < 4. 7. no.

1831. *Tiverton*.—Mr. H. Mudford. 3. 5.40. 4. a continuous shaking. 5. 8 or 10 secs. 7. no.

1832. Do.—(c. by Mr. W. E. Besley.) 6. < 4.

1833. *Torquay*.—Anon.* 3. 5.35. 4. a heaving wavy motion of the bed. 5. 2 or 3 secs. 6. 5. 7. no.

1834. Do.—Mr. R. Harria* 3. 5.37. 4. only one sh., a shaking or trem. motion as of sifting corn in a sieve. 5. 1 min. 6. < 4. 7. a very slight so.

1835. Do.—M. Black.* 3. some time before 6. 5. > 1 or 2 secs. 7. a slight roar like distant thunder, lasting ab. 3 secs. c. f.

1836. *Torrington*.—Col. C. W. Yonge.* 3. ab. 5.30. 4. 2 shs., the first lasting ab. 10 secs., the second following imm. and if anything of shorter duration. 6. < 4. 7. no.

1837. *Totnes*.—Dr. G. F. Yeo, F.R.S.† 3. 5.39. 4. there was a partial intermission of ab. $\frac{1}{2}$ sec., the second part seemed longer and more severe. 5. ab. 8 to 10 secs. 6. 5.

1838. *Witheridge*.—Mr. H. J. Mansfield. 3. ab. 5.40 or 5.45. 4. a vibr. such as might be caused by an express-train passing. 5. ab. 10 secs. 6. 5. 7. no.

1839. *Woodtown*.—Mr. W. F. Collier.* 3. ab. 5.30. 4. one set of rapid vibrs, wh. appeared to be all similar. 5. ab. 6 secs. 6. < 4. 7. no.

1840. *Yelverton*.—(*Western Morning News*, Plymouth, Dec. 18.) 3. ab. 5.35. 6. 4.

DORSET

1841. *Beaminster*.—Mr. R. Hart.† 3. ab. 5.37 A.M. 4. the motion like that made by a passing traction-engine. 6. pr. 4. 7. no.
1842. Do.—Mrs. G. F. Pinney.† 3. ab. 5.40. 5. ab. 20 secs. 7. as if a traction-engine were passing under the window.
1843. *Bere Regis*.—(c. by Rev. W. Farrer.) 6. 5.
1844. *Blandford*.—Mr. J. Richards. 3. bet. 5 and 5.30. 6. 5. 7. heavy waggons rumbling along for a few secs.
1845. Do.—(*Somerset County Herald*, Taunton, Dec. 19.) 3. ab. 5.30. 6. + 4. 7. a rumbling noise.
1846. *Boveridge*.—(*Salisbury and Winchester Journal*, Salisbury, Dec. 19.) 6. the bed moved distinctly.
1847. *Bridport*.—Rev. H. R. W. Farrer. 3. 5.30. 5. 5 to 10 secs. 6. 5.
1848. Do.—(*Pulman's Weekly News*, Yeovil, Dec. 22.) 3. 5.34. 6. 4.
1849. *Cerne Abbas*.—(c. by Rev. H. D. Gundry.) 4. sh. felt.
1850. *Corfe Castle*.—Rev. E. S. Bankes. 3. 5.40. 4. a wavy heaving motion. 5. 2 or 3 secs. 6. 5. 7. no.
1851. *Cranborne*.—Mr. T. Coombs.* 3. 5.40. 4. the movement like that made by a person walking across a very shaky floor. 5. 4 or 5 secs. 6. pr. 5.
1852. *Damory Court Farm* (near Blandford).—Mr. G. J. Groves.† 3. 5.33. 4. only one sh. g. N.E. to S.W. 5. only a few secs. 7. a rumbling noise. b. p.
1853. *Dorchester*.—Mr. F. B. Fisher.† 3. 5.30. 4. one sharp jolt, f. by trem. mot. for ab. 30 secs. 6. 5. 7. a confused rushing so. like a strong wind (though the air was still); the so. faded as the vibra. weakened; it seemed to roll away towards the S.W.
1854. Do.—(*Western Morning News*, Plymouth, Dec. 18.) 4. 4 or 5 waves. 6. 5. 7. a simultaneous rumbling noise.
1855. *Gillingham*.—Rev. Canon Davies.† 3. bet. 5.20 and 5.30. 4. a. yea. b. one series, ab. 10 secs. c. yea, 2 or 3 secs. d. yea. e. beg. f. yea. g. N. to S. 6. 5. 7. the rumbling of a distant train during the sh.
1856. *Holnest*.—(c. by Rev. C. H. Mayo.) 6. a picture was thrown down from the wall of a ground-floor room in a cottage.
1857. *Keynston Mills*.—Mr. W. J. Strange.* 3. 5.36 or 5.37. 4. two severe jerks, from ab. N.E. to S.W., f. by a swaying of the bed. 6. 5.
1858. *Langton Herring*.—Rev. C. H. Gosset (*Symons' Meteor. Mag.*, vol. 31, 1897, p. 179). 3. ab. 5.35. 4. g. E. to W. 5. 5 or 6 secs.
1859. *Long Burton*.—Rev. C. H. Mayo.* 3. 5.35. 4. only one sh., a vertical oscillation as if caused by a passing traction-engine. g. S. to N. (according to another obs.). 6. pr. 5. 7. the oscillation was p. and f. by a low rumbling so.
1860. *Maiden Newton*.—(c. by Rev. M. Hankey.) 6. pr. 5.
1861. *Nether-Compton*.—Rev. E. W. Goodden.* 3. 5.40. 4. the sh. was p. by a violent trem. mot. 5. ab. 5. secs. 7. no.
1862. *Oborne*.—(*Somerset County Herald*, Taunton, Dec. 19.) "the

oscillation of the houses was general; . . . in one instance, the ornaments on the toilet-table were overturned."

1863. *Poole*.—(*Somerset County Herald*, Taunton, Dec. 19.) 6. 4.

1864. *Shaftesbury*.—Mr. Long* (c. by Rev. F. Ehlers). 3. 5.30. 4. 2 sha., ab. 6 secs. bet. them, the first lasting ab. 3 secs., the second stronger and lasting about 30 secs. f. yes. 6. 5. 7. the passing of a steam-roller.

1865. *Sherborne*.—(*Somerset County Herald*, Taunton, Dec. 19.) 3. directly after 5.30. 5. 4. 7. rumbling sounds for 3 secs.—"Four of the telegraph wires where they cross the street near the Castle Hotel were found to be broken. Whether this was directly due to the shock of course it cannot be said; but the fact that the wires were in a good state, and that the frost up to that time had not been severe, points forcibly to only one conclusion. The town was cut off from all telegraphic communication with the big centres."

1866. *Do*.—(*Wilts and Gloucestershire Standard*, Cirencester, Dec. 19.) 4. beds shaken. 7. thunder.

1867. *Stalbridge*.—Rev. C. E. Seaman. 4, 7. the impression left was that of an unusually heavy and noisy traction-engine passing. 5. 7 or 8 secs. 6. 5.

1868. *Swanage*.—Mrs. G. Horlock † (c. by Mr. R. Slater). 3. ab. 5.40. 4. two trem. motions, the second occurring ab. $\frac{1}{2}$ a min. after the first; they lasted only for 1 or 2 secs. 6. 4. 7. no.

1869. *Wareham*.—Rev. S. Blackett. † 4. the bed shaken. 7. no.

1870. *West Lulworth*.—M. T. Schuster. 3. imm. after 5.30. 6. 5. 7. the sh. was acc. by a strange soft rushing overhead, like a very rapid flight of some soft-footed animals in a great body from one end to the other of the floor above.

1871. *Weymouth*.—Mrs. L. B. Weldon. † 3. 4.20 [*sic*]. 4. an upheaval of the bed. 5. ab. 10 secs. 6. 5.

1872. *Do*.—(*Daily Chronicle*, Dec. 18.) 3. 5.30. 6. 5? in one case a vase was displaced and broken to pieces.

1873. *Wimborne*.—Miss H. M. Snow. † 3. ab. 5.40 or 5.42. 4. 6 or 7 slight lifts, first on one side of the bed and then on the other. (Most persons here felt 2 sha. with a very short interval between.) 6. 5. 7. no.

HAMPSHIRE

1874. *Aldershot*.—M. Fountain.* 3. 5.27 A.M. 4. a shaking of the bed as if some person had stumbled up against it. 5. 2 or 3 secs. 7. a creaking or grinding so., wh. ceased before the sh. was felt.

1875. *Do*.—Rev. W. Wright.* 3. ab. 5.30. 5. 2 or 3 secs. 7. no.

1876. *Andover*.—Mr. P. E. Talbot † (c. by Mr. W. Heward Bell). 3. ab. 5.35. 4. two series, interval bet. ab. 15 secs. 6. 4.

1877. *Basingstoke*.—Miss A. Gould. 3. 5.40. 4. the house shook distinctly twice. f. yes. 5. some few secs. 6. 5. 7. a strange rumbling noise. b. p.

1878. *Bitterne*.—(c. by Lt.-Col. J. T. Buckmill, R.E.) 3. ab. 5.30. 6. pr. 5.

1879. Do.—Dr. M. White (*Standard*, Dec. 18). 3. ab. 5.40. 4. two distinct shs, the bed rocked. 6. 5. 7. a dull rumbling noise.

1880. *Bournemouth*.—Mr. W. H. Thorne. 3. 5.40. 4. a swinging to and fro, without interval, the swings diminishing in int. g. E. and W. 5. ab. 5 or 6 secs. 6. 5. 7. no.

1881. Do.—Mrs. Tarratt.* 3. bet. 5.15 and 5.30. 4. the bed was suddenly raised and swayed from N. to S.; in a few secs, it was again raised but in a much slighter degree. 6. 5. 7. no.

1882. Do.—Mrs. Casey. 3. bet. 5.25 and 5.35. 4. two series, separated by a very short interval, the second part stronger. g. N. to S. 6. < 4.

1883. Do.—(c. by Mr. E. H. Fairbrother.) 3. 5.33. 4. 3 series of vibra, each lasting ab. 5 secs. g. N.E. and S.W. 5. $1\frac{1}{2}$ mins.

1884. Do.—Mrs. Parry.† 3. ab. 5.30. 4. two distinct shs, both alike, separated by an interval of 2 or 3 secs. 6. 5.

1885. Do.—Miss I. M. Hartley.† 3. 5.39. 6. 4. 7. no.

1886. Do.—Mr. W. A. Wheaton.† 4. the foot of the bed (towards the W.) appeared to sink down and then imm. rose again rather slowly. 7. the sh. was acc. by a low rumbling so. like distant thunder.

1887. Do.—Mr. F. T. East. 3. ab. 5.30. 6. 4. 7. an explosion.

1888. Do.—Mr. A. Adams.* 3. bet. 5 and 6. 5. several secs. 6. pr. 5. 7. no.

1889. Do.—Mr. J. A. E. Lewis.* 6. 4. 7. a long rumbling so.

1890. Do.—Miss A. N. Abbott. 3. ab. 5.30 or 5.50. 4. the movement like that made by a passing traction-engine. 5. some secs. 6. 4. 7. a traction-engine passing.

1891. Do.—Mrs. W. Haydon.† 3. 5.35. 4. a quick vibr. 6. < 4. 7. no.

1892. *Christchurch*.—Mr. G. M. Smooker.† 3. 5.40. 4. a very decided rolling or pitching sensation, like the movement on board ship in a very heavy sea. 6. 5. 7. several steam-rollers at work.

1893. *Crandall*.—Miss E. Stevens.† 3. 5.35. 4. a violent tremor, without any rocking. 6. 4. 7. no.

1894. *Durley*.—(c. by Rev. J. Jenkyns.) 3. 5.30. 4. the bed rocked E. and W. 5. several secs. 6. 5. 7. a rush of wind.

1895. *Farnborough*.—Mrs. Reid.* 3. 5.33. 4. the window frame creaked loudly, and, ab. $\frac{1}{4}$ min. later, the bed rocked 3 times from head to foot. g. ab. N.W. and S.E. 5. ab. 7 or 8 secs. 6. 5. 7. no.

1896. *Fordingbridge*.—Mr. C. M. Lefroy.† 3. ab. 5.35. 4. 2 movements, at ab. 10 secs interval. f. no. 5. ab. 3 secs each. 7. no.

1897. *Goodworth House* (near Clatford).—Mr. A. L. Donaldson.* 3. ab. 5.40. 4. a very distinct vibr. of the house, wh. ceased and was f. by a rattling of the windows. 5. 3 secs. 7. a passing train, with the first vibr. b. p.

1898. *Hartley Wintney*.—(*Standard*, Dec. 19.) 5. several secs. 7. a rumbling noise, growing louder as it seemed to approach the house.

1899. *Hawley*.—Miss R. Eyton.† 3. 5.35. 6. < 4.

1900. *Hincheslea*.—Miss M. Lovell.* 3. ab. 5.30. 4. the bed first shook and then gave a slight upheaving motion. 5. ab. 10 secs. 6. 5. 7. a rumbling so. like a very heavy train passing; after a sec. or two, this

seemed to increase sufficiently to cause the windows to rattle considerably, then the bed shook and upheaved. b. p.

1901. *Houghton Lodge* (near Stockbridge).—Miss A. Field.* 3. 5.30. 4. one distinct sh., the bed swayed to and fro. 6. 5. 7. distant thunder.

1902. *Hythe*.—Miss A. Chalmers. 3. bet. 5.30 and 5.40. 4. the bed trembled. 7. a slight so. after the sh.

1903. *Liphook*.—Mr. G. Carley. 3. ab. 5.30. 4. (according to another obs.) the bed moved 4 times in ab. 2 secs. 7. a rushing wind at a great distance, lasting ab. a sec.

1904. *Milford*.—Miss A. Magnay.† 3. 5.35. 4. the bed rocked very decidedly from S. to N. 6. 5. 7. after the sh. passed, there was a rumbling so., like distant thunder, wh. lasted ab. 3 or 4 secs.

1905. *Minley*.—Mrs. A. H. Wodehouse.† 3. 5.32. 4. one continuous vibr. lasting 88 secs., then a pause of 6 secs., and another slight vibr. lasting 11 secs. 6. 4. 7. a peculiar hissing or rustling so., like that of wind in pine-trees, wh. c. with the shaking, but died away before the second series.

1906. *Portsea*.—E. L. Cook.* 3. bet. 5.30 and 6. 4. two distinct sha., the first, if anything, the stronger; the sha. lasted ab. 3 or 4 secs. each, interval bet. them ab. 20 secs. g. N. to S. 6. 5. 7. no.

1907. *Regent's Park* (near Southampton).—Mrs. Neville Ward. 3. 5.40. 4. a very slight shiver of the bed. 7. no.

1908. *Southampton*.—Mr. C. Cooksey (*Times*, Dec. 18). 3. 5.40. 4. two sharp and distinct tremors of the bed.

1909. Do.—(*Daily Chronicle*, Dec. 18.) 3. 5.40. 4. sh. felt. 7. no.

1910. *Southsea*.—Miss M. C. T. Greenfield.† 4. one set of vibra. like those made by a heavy waggon passing the house. 5. 4 secs. 6. < 4.

1911. *Twyford*.—(*Salisbury and Winchester Journal*, Salisbury, Dec. 19.) 6. 4.

1912. *Winchester*.—(c. by Mr. N. C. H. Nesbitt.) 4. a gentle swaying motion, from ab. N. to S., no interval noticed. 6. pr. 5. 7. no.—“A string tied from the bed of the observer to the pillow of another sleeper, and running practically N. and S., was alternately slackened and tightened enough to awake the sleeper, who thought his usual mode of awakening was being prolonged more than usual.”

1913. Do.—(*Salisbury and Winchester Journal*, Salisbury, Dec. 19.) 4. a longitudinal movement of the bed 3 or 4 times. 6. < 4.

ISLE OF WIGHT

1914. *Cowes*.—(*I. of Wight County Express*, Newport, Dec. 19.) 4. a shaking of the room like that caused by the passage of some abnormally heavy goods-train.

1915. *Freshwater*.—Mr. Woodford (c. by Mr. W. Drewett). 4. two sha., ab. 6 secs. apart, of equal int.

1916. *Freshwater Bay*.—Anon.* (c. by Mr. W. Drewett). 3. 5.31 A.M. 4. the bed was shaken strongly as if by some one who had hold of the foot-rail; ab. 10 secs. afterwards, another equally violent sh. was felt. 6. pr. 5. 7. no.

1917. *Newport*.—Mr. W. L. Whatmore (*I. of Wight County Express*, Newport, Dec. 19). 3. 5.30. 4. distinctly felt the room move. 7. a rumbling noise at the same time.

1918. *Shanklin*.—(Do., Dec. 24.) 3. ab. 5.30. 4. a violent shaking, as if a heavy goods-train were passing. 5. several secs. 6. during the shaking, a dress slipped off a chair to the ground.

1919. *Yarmouth*.—(Do., Dec. 19.) 3. 5. 4. 2 distinct sha.

SUSSEX

1920. *Arundel*.—Miss R. C. Tompkins.† 3. 5.11. 4. 2 sha., each lasting ab. 5 secs, interval ab. 10 secs; the motion as if some one had taken hold of the bed-posts and shaken the bed. 6. pr. 5. 7. no.

1921. *Bognor*.—A. L. Farr.† 3. 5.30. 4. the bed shook. 7. (according to another obs.) a so. like a traction-engine passing.

1922. *Brighton*.—M. Hudson.* 3. bet. 5 and 6. 4. a sharp shake lasting ab. 1 sec., f. after an interval of a sec. by a slighter sh.; the first sh. was a single sharp rocking motion apparently from W. to E. 7. the obs. imagined that she heard the rumbling of a distant steam-roller.

1923. *Chichester*.—(c. by Mr. N. C. H. Nesbitt.) 4. sh. felt.

1924. *Chiddingly*.—Major J. V. Grant.† 3. ab. 5.30. 7. the rumbling of a heavy waggon, for ab. 5 secs.

1925. *Ferring*.—Mr. Henty* (c. by Rev. A. M. Deane). 3. 5.30. 6. 4.

1926. *Framfield*.—(c. by Mr. C. Dawson, F.G.S.) 3. ab. 5.30. 4. the house and bed shook. 7. the sh. was acc. by a rumbling so. like a heavy traction-engine passing.

1927. *Treherne Cottage* (near Horsham).—Mr. J. T. H. Lampard. 3. just after 5.30. 6. 4. 7. a rushing so. b. p.

1928. *Wimblehurst*.—Mr. E. Allcard.† 4. two shakes of the door; a few secs. between.

1929. *Worthing*.—Mrs. Whyley. 3. just after 5.30. 4. one sh., a rocking of the bed, like the motion felt on board a vessel. 5. ab. 2 secs. 6. 5.

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1930. *Addlestone*.—Mr. G. B. Edwards.† 3. 5.35 A.M. 4. a violent upheaving of the bed as though some one were pushing it from underneath. 5. a few secs. 6. 5. 7. another obs. heard a rumbling noise.

1931. *Do.*—(c. by Mr. G. B. Edwards.) 4. two shakes, the second stronger and directly after the first.

1932. *Bramley*.—Mrs. A. R. Baker.† 3. ab. 5.35. 4. an undulatory movement rather than a sharp shake; the top of the house seemed to sway 4 or 5 times as if it were going over a chopping sea. g. ab. N. to S. 6. 5. 7. one person heard a loud noise.

1933. *Camberley*.—Miss H. G. Orr.† 3. a little after 5.30. 4. as if a

series of wavelets were passing under the house. g. E. (or slightly S.E.) to W. (or N.W.).

1934. Do.—E. Heathcote. 4. bed rather violently shaken. 7. no.

1935. *Chertsey*.—(c. by M. E. Brettell.) 3. ab. 5.30 or 5.31. 4. only one sh. g. N. and S. 6. 5. 7. one person heard a rustling so., as of wind among leaves.

1936. *Chiddingfold*.—Mr. A. F. Parbury. 3. 5.37. 4. one sh. only. 5. 3 or 4 secs. 6. 4. 7. distant thunder or the rumbling of a heavy waggon. b. p.

1937. *Cranleigh*.—H. H. Joyce. 3. ab. 5.40. 4. a shaking like that caused by a steam-roller or heavy waggon passing. 5. pr. 4 or 5 secs. 6. < 4. 7. no.

1938. *Croydon*.—Mr. L. Carrington. 3. ab. 5.30. 4. a. no. b. 3' defined vibrs., the second and strongest rapidly following the first, and the third, of less int. after an interval of ab. 5 secs.; the sensation was similar to that felt in a boat tilted when broadside on by a wave, not violent but jerky. g. E and W. 5. ab. 5 or 6 secs. 6. 5.

1939. Do.—Mrs. T. S. Wickstead.† 4. as if some one were walking ab. the room. 6. 3. 7. no.

1940. Do.—Anon.* (*Daily News*, Dec. 21). 3. ab. 5.35. 6. 4. 7. a traction-engine passing. b. p.

1941. *Dorking*.—M. A. Farmer. 3. ab. 5.30. 4. like the shaking caused by a heavy train passing. 5. > 2 secs. 6. 5. 7. no, but, according to two other persons, like a rush of wind and a train passing.

1942. Do.—Mr. R. B. Reid.† 3. 5.31. 4. the bed rocked with a motion like that imparted to a ship when the screw is out of the water and "racing." g. S.W. to N.E. 5. 6 or 7 secs. 6. 5. 7. a slight so. of a muffled rumbling character. c. c.

1943. Do.—Mrs. Evans. 3. 5.30. 4. suddenly the bed rocked twice. 6. 5. 7. no.

1944. *East Molesey*.—Mr. B. W. Ginsburg.† 3. ab. 5.40. 4. like the roll of a small vessel at anchor when a swell on the beam takes her. g. ab. N. to S. 6. 5.

1945. *East Sheen*.—Anon.* (*Standard*, Dec. 18). 3. 5.40. 6. pr. 4.

1946. *Englefield Green*.—"S. H."* (*Morning Post*, Dec. 18). 3. bet. 5.34 and 5.35. 4. g. W. to E. 5. ab. 10 secs. 6. pr. 4. 7. a rumbling cart.

1947. *Epsom*.—Mr. S. Hankey* (c. by Mr. J. G. Wood). 3. 5.30. 4. g. W. to E. 5. ab. 5 secs. 7. the vibr. was imm. f. by a so. as of a gust of wind through tree-tops, lasting ab. 5 secs.

1948. *Esher*.—(*Standard*, Dec. 19.) 5. a few secs. 6. 5.

1949. *Ewell*.—E. Wood.* 5. 5 to 6 secs. 6. 5? 7. no.

1950. *Godalming*.—Miss A. M. Haig-Brown.* 3. shortly after 5.30. 4. the bed shook and rocked, at first gently and then more violently. 5. 4 or 5 secs. 6. 5. 7. no.

1951. *Guildford*.—(*Standard*, Dec. 18.) 3. ab. 5.30. 4. 2 distinct shs. 7. a rumbling so.

1952. *Hersham*.—Mr. H. Freeston.† 3. 5.35. 4. the sh. in 2 parts, ab. 3 secs. bet. them, the second stronger. 5. ab. 2 secs. 6. 5. 7. no.

1953. *Kew Gardens*.—Hon. Mrs. Turnour.* 3. 6.30 [*sic*]. 4. a swinging motion, repeated in the opposite direction after a few secs. 6. 5. 7. no, but another obs. heard a loud rumbling like that of a powder explosion.
1954. *Kingston-on-Thames*.—(*Standard*, Dec. 19.) 4. sh. distinctly felt.
1955. *Leigh*.—J. Lucas. 3. 5.40. 4. the sh. in 2 parts close together, the first stronger. 6. 5? 7. a rumble as if some one had rolled down a flight of stairs; the beg. of the so. c. with the end of the sh.
1956. *Long Ditton*.—(*Standard*, Dec. 19.) 6. 5.
1957. *Merton*.—Mr. S. Jackson.† 3. bet. 5.30 and 5.35. 4. the bed gently undulated as if on a rippling wave running from N. to S. 6. pr. 5.
1958. *New Malden*.—Mr. J. Ayres.* 3. 5.34.* 4. a sudden lift up and then a violent shaking. 5. ab. 3 secs. 6. 5. 7. no.
1959. *Nutfield*.—Mr. H. P. Nickalls.† 3. 6.37 [*sic*]. 5. > 2 secs. 6. 5? 7. a train passing.
1960. *Nutwood*.—Anon.† (c. by Mr. H. E. Gurney). 3. ab. 5.30. 5. ab. 4 secs. 7. a heavy waggon passing.
1961. *Orstead*.—Rev. F. Parnell. 3. bet. 5.30 and 5.45. 4. the window-frame rattled gently 4 or 5 times. 6. 4.
1962. *Redhill*.—Mr. J. Sterry. 3. just after 5.30. 4. the bed rocked from ab. N. to S. 3 times at a small portion of a sec. apart; the motion from N. to S. was distinct, but the return from S. to N. was not perceptible. 6. 5? 7. no.
1963. Do.—(*Daily News*, Dec. 18.) 3. 5.30. 4. the bed violently shaken as if by some powerful person. 6. 4 or 5.
1964. *Richmond*.—Mrs. Caddy. 3. shortly before 5.40. 4. no sh. felt. 7. like a long slow steady knocking with a muffled knocker at the front door.
1965. *Richmond Hill*.—Mrs. Saunders.† 3. ab. 5.35 or 5.40. 4. ab. 5 slow swings of the bed. 6. 5. 7. a rumbling so. b. p. imm.
1966. Do.—Mr. P. J. Pring. 3. 5.30. 4. the bed perceptibly heaved very gently 2 or 3 times. 5. 3 or 4 secs. 6. 5.
1967. *St. Catherine's*.—F. J. Davis.* 4. the bed shook twice. 6. 4. 7. no.
1968. *Shalford*.—Mrs. Godwin-Austen.† 4. g. N. and S. 6. pr. 5. 7. no.
1969. *Shamley Green*.—Mr. M. Taylor. 3. 5.30. 4. two series, the first stronger, ab. a min. bet. them. 6. 4. 7. no.
1970. *South Nutfield*.—Anon.* (c. by Miss F. M. Browell). 3. ab. 5.30. 4. a rocking motion from side to side. 6. pr. 5. 7. no.
1971. *Surbiton*.—(*Standard*, Dec. 19.) 6. 5.
1972. *Thursley*.—Mr. J. Gray.† 3. bet. 5.35 and 5.40. 5. ab. 5 or 6 secs. 6. 5. 7. no.
1973. *Walton-on-Thames*.—Miss N. Phillips.* 3. 5.40. 4. 2 vibrs., f. by a trem. mot. 6. pr. 5. 7. no, but other observers heard a so. as of a strong gust of wind.
1974. Do.—E. Dee.* 3. bet. 5 and 6. 4. 2 series of vibrs., the second stronger. 7. a so., like a strong gust of wind, with the first series.
1975. *Weybridge*.—(*Standard*, Dec. 19.) 3. soon after 5. 4. sh. very distinct. 7. an explosion.

1976. *Weybrook* (near Guildford).—Mr. R. Grange† 3. 5.36. 4. 2 series of rapid oscillations, each lasting ab. 2 or 3 secs and separated by an interval of ab. 2 secs. 6. < 4. 7. no.

1977. *Wimbledon*.—Anon. 3. 5.35 or 5.40. 4. two bumps. 5. 3 or 4 secs. 6. < 4. 7. so. heard after the sh. for 4 or 5 secs.

1978. Do.—(*Morning Post*, Dec. 18.) 3. ab. 6. 4. several shs. [vibra. ?], the first most severe, f. imm. by others lasting several secs. and gradually becoming weaker. 6. 4. 7. no.

1979. *Windlesham*.—Mr. C. A. Benn. 4. a. small trem. mot. b. suddenly 3 distinct vibra. c. slight. d. movement incr. in int. and stopped suddenly, except for small after-tremor. 6. pr. 5.—Outside the observer's door is an open cistern used for feeding hot-water pipes; the movement generated a wave in the cistern, causing the water to overflow.

1980. Do.—Mr. E. S. Currie† 3. 5.34 or 5.35. 4. one series, of 3 or 4 vibra. in quick succession. f. no. 5. 2 to 4 secs. 6. 5. 7. a rushing so. before, but pr. not during, the sh.

1981. *Worcester Park*.—M. Hodges† 3. ab. 5.30. 4. a violent heaving of the bed. g. E. to W. 6. 5.

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1982. *Beckenham*.—Mrs. Stevenson.* 3. bet. 5 and 6 A.M. 4. a strong swinging motion, f. imm. by a sharp quick vibr.; a min. or so later a second sh. precisely similar but much fainter. 5. 3 secs. (first sh.). 6. 5.

1983. *Brenchley*.—Anon.* (c. by Capt. J. Ruxton). 3. soon after 5.30. 4. no sh. felt. 7. a rumbling noise.

1984. *Canterbury*.—(c. by Miss L. Canning.) 4. g. S. to N. 5. ab. 2 secs.

1985. *Chislehurst*.—Mr. F. Mytton. 3. 5.32. 4. the bed shook slightly as though a heavy train were passing. g. E. and W. 5. ab. 3 secs. 6. 4. 7. no.

1986. Do.—Mr. E. Myers* 4. 2 distinct vibra. close together, like throbs or shivers. 6. < 4. 7. no.

1987. *Hayes*.—(c. by Mr. A. Torrens.) 3. bet. 5.35 and 5.40. 4. 2 distinct shs., separated by a few secs., the first longer and more severe. 5. ab. 12 to 15 secs. 6. 5. 7. no.

1988. *Selling*.—Sir F. Osborne, Bart. 3. ab. 5.30. 5. a few secs. 6. < 4.

1989. *Sevenoaks*.—W. W. Wapstaffe (c. by Mr. G. J. Symons, F.R.S.). 3. 5.30. 4. sh. felt by several persons.

1990. *Shortlands*.—H. H. Colvill. 3. ab. 5.30. 4. 2 series, each lasting several secs. 7. no.

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I.—SURREY

(a) *London, S.W.*

1991. *Balham*.—S. A. Kearton.* 3. 5.35 A.M. 6. 5.
 1992. *Battersea*.—Mr. H. J. Bradforth.* 3. 5.36. 4. 2 series of vibra., separated by an interval of ab. 3 to 5 mins. [sic]. 6. 4. 7. no.
 1993. *Brixton*.—M. F. Churchyard.† 3. 5.40. 5. ab. 10 or 12 secs. 6. 5. 7. no.
 1994. *Clapham*.—Mr. E. F. Bird * (*Daily Telegraph*, Dec. 19). 3. bet. 5.30 and 6. 4. a violent lateral vibr., 4 distinct movements in rapid succession. g. S.W. to N.E. 5. > 2 or 3 secs. 6. 4.
 1995. *Clapham Park*.—Anon.† 3. bet. 5.30 and 5.35. 4. the bed rocked twice like a boat on a rough sea from N.E. to S.W. 5. ab. 2 secs. 6. 5. 7. no.
 1996. *Putney Hill*.—Mr. S. W. Lee. 3. ab. 5.30. 6. 5?
 1997. *Streatham Common*.—Mr. J. Mitstead. 3. 5.35. 4. a severe shake. 5. 2 or 3 secs. 7. yea.
 1998. *Upper Tooting*.—A. E. Schlötel. 3. 5.30. 4. 5 distinct sha. [vibra. ?], 4 in quick succession, the fifth less intense and after a longer interval. 5. 7 to 8 secs. 6. 5. 7. no.
 1999. *Wandsworth Common*.—Mrs. Diplock.† 6. 5? 7. no.

(b) *London, S.E.*

2000. *Bermondsey*.—M. Willoughby.* 3. 5.35. 6. 5?
 2001. *Dulwich*.—Mr. F. L. Smith.† 3. 5.35. 4. a slight swinging of the bed. 5. ab. 6 secs. 6. pr. 5.
 2002. Do.—Mr. B. Kench.† (*Daily Mail*, Dec. 18). 3. 5.37. 4. g. S.W. to N.E.
 2003. Do., near.—(*Standard*, Dec. 18.) 3. ab. 5.32. 5. ab. 8 or 10 secs. 6. 5?
 2004. *East Dulwich*.—Mr. J. Cæsar. 3. 5.36½. 4. 5 or 6 gentle regular oscillations of the bed. g. W. to E. 5. 3 to 4 secs. 6. 5?
 2005. Do.—Mr. C. Hollingsworth.* 3. ab. 5.40. 4. the movement like that caused by a bare-footed person walking heavily across an adjoining room.
 2006. *Norwood*.—Mr. J. C. Kendall.* 3. 5.33. 4. like 3 small waves passing under the chair. 5. ab. ¼ min. 6. 4 or 5. 7. a low rumbling noise. b. p. ab. 3 secs. c. f. ab. 5 secs.
 2007. Do.—E. A. P. Gerick.† 3. a little before 5.45. 4. a rocking of the bed. g. E. and W. 5. 5 or 6 secs. 6. 5. 7. no.
 2008. *Upper Norwood*.—(*Standard*, Dec. 19.) 4. the vibra. like those caused by the passing of a very fast train, only more intense.

II.—KENT

London, S.E.

2009. *Blackheath*.—Major I. W. Sill, R.E.† 3. ab. 5.30. 5. $\frac{1}{4}$ to $\frac{1}{2}$ min. 6. 5? 7. no.

2010. Do.—Anon.† (c. by Mr. A. F. Pitman). 3. soon after 5.30. 4. 2 shs felt by other observers. 6. pr. 5. 7. no.

2011. Do.—Mr. T. Dinwiddy.* 3. 5.30. 4. the bed vibrated as though shaken by a strong hand. g. E. to W. 5. a few secs. 7. no.

2012. *Deptford*.—Rev. G. Bruce Rhind (*Daily Telegraph*, Dec. 19). 3. bet. 5.30 and 5.45. 4. a movement like that of shaking a sieve horizontally. g. N. to S. 5. ab. 3 or 4 secs.

2013. *Grove Park*.—Anon.* (c. by Mr. J. B. Sly). 3. ab. 5.33. 6. pr. 5.

2014. *Lee*.—E. A. Williams. 3. bet. 5 and 6. 4. 3 distinct vibra at regular intervals, like those of a heavy tread across the room.

2015. *Lewisham*.—Mr. T. P. Briscoe. 3. ab. 5.30. 4. 2 distinct vibra g. E. to W.

2016. *St. Johns*.—Mr. E. R. Housdon. 3. 5.30. 4. distinct and continuous undulation. g. N.W. to S.E. 5. ab. 10 secs. 6. pr. 5. 7. no.

2017. *Sydenham*.—M. Becher.* 3. 5.35. 4. only one sh., the whole house seemed tilted up. g. N. to S. 5. a very few secs. 6. 5; some china on a shelf slid forward to the edge of the shelf, from $\frac{1}{2}$ to 1 inch.

2018. *Woolwich*.—Capt. H. Hulcate, R.E.† 4. one continuous shaking. 7. no.

III.—MIDDLESEX

(a) *London, W.C.*

2019. *Brunswick Square*.—Anon.* (c. by Prof. R. Meldola, F.R.S.). 4. there were 3 distinct stages, separated by intervals of some secs., the first two ab. equal in int., the third most distinct, (1) a sensation as of some one moving about the room, (2) a so. wh. seemed like the gnawing of a mouse, (3) a rising of the bed as if some one were underneath, trying to push it up. 6. 5.

2020. *Russell Square*.—(*Standard*, Dec. 21.) 6. 5.

(b) *London, E.C.*

2021. *St. Swithin's Lane*.—Mr. E. L. Scott* (*Times*, Dec. 18). 3. 5.35. 4. a gentle and not unpleasant swinging of the bed. g. N. to S. 6. 5?

(c) *London, S.W.*

2022. *Chelsea*.—Mr. B. Warhurst (*Daily Mail*, Dec. 18). 3. bet. 4 and 5 [*sic*]. 4. the bed oscillated twice, a swinging sensation. 7. no.

2023. *Pimlico*.—C. E. Vane. 3. shortly before 5.30. 4. the bed rocked gently 3 or 4 times.

2024. *South Kensington*.—Mr. A. Cary.* 3. 5.35. 6. 5. 7. a rumbling noise, wh. f. the sh. in a few secs.

2025. Do.—Anon.† 3. ab. 5.30. 4. a distinct vibr. 7. acc. by a noise like the rumbling of thunder underground, lasting 3 or 4 secs.

2026. Do.—Mr. H. M. Cockerell (*Times*, Dec. 18). 4. a rolling movement of the bed. 5. ab. 2 secs.

2027. *Westminster*.—Mr. E. Wright.* 3. ab. 5.20. 4. a slight upheaval. 6. pr. 5. 7. a rather loud rumbling noise, loudest at the beg. and grad. dying away; it lasted several secs. and was f. by the upheaval.

2028. Do.—Admiral H. J. Blomfield.* 3. ab. 5.30. 4. f. no. g. N.W. and S.E. 5. ab. 2 secs. 6. < 4. 7. no.

2029. Do.—Col. T. E. Green.* 3. ab. 5.35. 4. a violent shaking from side to side. g. ab. E. and W. 5. ab. 7 secs. 6. pr. 5.

(d) *London, W.*

2030. *Baywater*.—Mr. H. A. A. Cruso.* 4. one series, as if a heavy traction-engine were passing. 5. $2\frac{1}{2}$ secs. 6. 4. 7. the quivering, jarring so. wh. a steamer's machinery makes when the boat stops.

2031. Do.—Miss G. E. Burrows. 3. ab. 5.30. 4. began with a violent tremor, and then the bed was lifted up. g. W. to E. 5. a few secs. 6. 5. 7. a rattling and rumbling so.

2032. Do.—Mr. R. M. Minton-Senhouse † (*Standard*, Dec. 18). 3. ab. 5.40. 4. the bed swayed 2 or 3 times from N. to S. 6. 4 or 5.

2033. *Kensal Rise*.—Mrs. W. Hunt (*Daily Telegraph*, Dec. 19). 4. the bed suddenly shook and rose slightly, as if some one beneath were pushing it up.

2034. *Kensington*.—Mr. L. Thierry.† 3. before 6. 6. < 4.

2035. *Mayfair*.—Anon.* 5. some secs. 6. pr. < 4. 7. a heavily laden waggon passing.

2036. *North Kensington*.—A. Stephenson. 3. ab. 5.30 or 5.35. 4. a violent tremor, interval of a few secs., a second and weaker tremor, another pause of a few secs., and then a third and weaker tremor. 5. ab. 15 secs. 7. no.

2037. Do.—M. G. Lupton. 4. the bed was shaken and seemed to be twisted 2 or 3 times very strongly. 6. 5.

2038. *Notting Hill*.—(c. by Mr. W. Milner.) In a semi-detached house facing N., many of the ceilings were damaged, all the cracks starting from the walls, and running from S.E. to N.W., except one, wh. was from N.E. to S.W.

2039. Do.—Mr. W. Milner.* 3. bet. 5.32 and 5.33. 4. 4 complete oscillations of the bed, the first two ab. equal, the third strongest. g. E. and W. 5. ab. 5 secs. 6. 5. 7. no.

2040. Do.—Mr. T. Blake Wigman.† 3. bet. 5.30 and 6. 4. the bed rocked from E. to W. 6. 5. 7. an underground train.

2041. Do.—Mr. J. G. Lemon.† 3. ab. 5.30. 4. felt no sh. 6. a

8-day clock facing S. on a mantelpiece on the ground fl., wound up the previous day, stopped at 5.45. 7. the noise made by water in a cistern at boiling temperature.

2042. Do.—Miss E. K. Lawder.† 3. 5.30. 4. 3 vibra, as if a large animal under the N.E. end of the bed were raising it and shaking it backwards and forwards. 6. 5. 7. no.

2043. Do.—Mr. I. Davis. 4. felt the house go down twice, apparently ab. 2 ins. the first time and ab. 3 ins. the second. 6. 5.

2044. *Palace Court*.—Mr. J. T. Black.† 3. 5.40. 4. one sh. only. 7. no.

2045. *Shepherd's Bush*.—Miss C. L. Dawson.* 3. bet. 5.30 and 5.35. 6. 4. 7. as if a very high wind rustled all the garments hanging in the wardrobe, the door of wh. was open. b. p.

(e) *London, N.W.*

2046. *Brondebury*.—Mr. H. Fabian * (*Standard*, Dec. 18). 3. 5.33. 5. 3 or 4 secs. 6. 4 or 5.

2047. *Camden Town*.—Mr. A. Stone.* 3. 5.34 or 5.35. 4. one series. 5. ab. 5 secs. 6. pr. 5. 7. no.

2048. *Hampstead*.—Anon.† 3. 5.32 to 5.33. 4. 2 parts, the second stronger, interval bet. them pr. 6 or 7 secs. 6. 5. 7. the charge of a battery of artillery over a macadamised road at, say, 300 yards' distance, as if approaching, passing and grad. disappearing. b. c., almost. c. p. ab. 2 secs.

2049. Do.—Mr. H. A. Nesbitt.† 3. ab. 5.30. 5. ab. 5 secs. 7. a dull rumble, the sh. f. the so. at a short interval of at most 1 or 2 secs.

2050. Do.—Mr. J. Clarke.* 3. 5.30. 4. the bed seemed to roll. 6. < 4. 7. a loud report like the so. of musketry at a distance.

2051. Do.—(c. by Mr. D. B. Squire.) 3. 5.30. 4. f. no; another obs., who had a hot-bottle against her neck, felt the water move in it. 7. no.

2052. *Harlesden*.—Mr. F. J. Rayner. 3. 5.30. 4. 3 or 4 vibra. 5. 3 or 4 secs. 6. 5. 7. the sh. f. by a so. as of rustling wind.

2053. *Kentish Town*.—Mr. J. S. Ledbury.* 4. a slight lateral swaying, E. and W., of 3 or 4 beats, and after ab. 15 secs. this was repeated for 3 or 4 beats; in ab. 10 secs. the house was violently shaken for ab. 4 secs. 6. end. 6. 5. 7. no.

2054. *Maida Vale*.—H. Haynes.† 4. the floor heaved twice and the bed rocked. 6. pr. 5. 7. a noise, like that of a train passing, f. the sh., becoming grad. fainter, and lasting ab. 20 secs.

2055. *Primrose Hill*.—Mr. T. Gregory.* 3. 5.31. 4. the bed moved as if on a wave. 6. 5. 7. a rumbling noise.

2056. *St. John's Wood*.—F. Johnson.* 3. 5.38. 4. as if the bed were a swinging hammock. 5. ab. 6 secs. 6. 5. 7. no.

2057. Do.—Rev. H. Alston. 3. 5.35. 4. 2 vibra, the second f. the first imm. 6. 5. 7. no.

2058. *South Hampstead*.—Mrs. Meakin.* 3. 5.38. 4. 2 distinct shs., a

few secs. bet. them. 5. 3 or 4 secs. 7. a heavy underground luggage train; the so. p. the sh., perhaps entirely.

2059. Do.—Mr. R. B. Harting. 3. 5.34. 4. the bed shaken 6 times, two distinct parts, the interval bet. them only momentary. 5. 5 secs.* 7. no.

2060. *West Hampstead*.—Mr. J. R. Spink. 4. g. E. and W. 5. a few secs. 6. 5. 7. a rumbling, as of something heavy passing the house, from E. to W.

(f) *London, N.*

2061. *Canonbury*.—Mrs. Nicholson.* 3. 5.30. 4. the bed rose and rocked. g. N. to S. 5. momentary. 6. 5. 7. the so. c. with the sh.; the so. came from the W.

2062. Do.—E. M. Lovell.† 3. 5.33 or 5.34. 4. a very distinct rocking motion, ab. 4 movements in one series. g. N. to S. 5. ab. 3 secs. 6. 5. 7. no.

2063. *Finsbury Park*.—Mr. W. Rosselli.* 3. 5.27. 4. 3 distinct undulations, a pleasant sensation, lasting $2\frac{1}{2}$ secs.; then a slight interval of 1 to 2 secs., f. by a vibr. wh. made the windows rattle. d. S.W. to N.E. 6. 5.

2064. *Highbury*.—Mr. C. Nicoll.* 3. ab. 5.35. 4. the bed was heaved and then dropped, f. by an oscillation for ab. 4 secs. 6. 5.

2065. *Highgate*.—Mr. J. W. Colmer* (*Standard*, Dec. 18). 3. 5.35. 5. nearly $\frac{1}{2}$ min. 6. 4.

2066. Do.—Mr. R. Bligh (*Daily Mail*, Dec. 18). 3. ab. 5.30. 4. a violent trembling and then a distinct upheaval.

2067. *Holloway*.—Mr. W. J. Roffey.† 4. ab. 6 or 8 rapid vibrs. 5. ab. 4 or 5 secs. 6. 5? 7. the rustling of leaves by a strong wind. c. c.

2068. Do.—Mr. W. J. Walter.† 3. bet. 5.30 and 6. 4. one series, the bed shaken horizontally. 6. 5. 7. no.

2069. *Islington*.—Mr. R. Strachan.* 3. bet. 5 and 6. 6. 4.

2070. *Muswell Hill*.—Mr. W. G. Peason.* 3. 5.34. 4. a smooth, pleasant, gentle rolling, 4 times each way, like the rocking of a boat in a gentle swell. 5. 3 or 4 secs. 6. 5. 7. no.

2071. Do.—Mr. T. Dixon. 3. ab. 5.30. 5. several secs. 6. 5? 7. yes.

2072. *Stamford Hill*.—Mrs. Fabian.† 3. bet. 5 and 6. 4. gentle rocking, 3 or 4 times, from E. to W.; f. imm. by a rattling of crockery. 6. 5.

2073. *Tufnell Park*.—Mr. W. Meacher.† 3. 5.34.* 4. 4 distinct pushes, as if the bed were set in motion like a pendulum, and as if a fresh impulse were given before it had attained its full return swing; then, after a pause of 3 secs., a long heave with 3 very quick tremors in the middle. 5. 8 to 10 secs. 6. 5. 7. no.

2074. Do.—Mr. W. B. Carter (*Daily Mail*, Dec. 18). 6. pr. 5.

2075. *Wood Green*.—Mr. J. H. George.† 3. 5.30. 4. 4 distinct shs., a sec. bet. each. g. N. to S. 6. 5. 7. a so. wh. passed away with the last sh.

(g) *London, N.E.*

2076. *Hackney*.—Mr. W. J. O. Harle. 3. ab. 5.30. 4. only one sh. 5. > 20 secs. 6. < 4. 7. no.

MIDDLESEX

2077. *Acton*.—Mr. S. B. Maynard * (*Daily Telegraph*, Dec. 18). 3. bet. 5.15 and 5.45. 4. a swaying movement like the rolling of a steamer. g. W. to E. 6. 5. 7. an explosion of gas, f. imm. by the sh.

2078. Do.—(*Daily Mail*, Dec. 18.) 6. < 4. 7. the sh. acc. by a hissing so.

2079. *Alperton Hall*.—D. Morse.† 3. bet. 5.30 and 6. 4. a trem. shaking, as if an abnormally heavy goods-train were passing. 5. ab. 15 secs. 6. 4. 7. a low deep rumble, like distant thunder, wh. continued for some secs. after the vibra. stopped.

2080. *Brentford*.—Mr. C. J. Cross, J.P. 3. 5.35. 4. one sh. only; another obs. thought some one was under the bed rocking it, and, jumping out into the middle of the room, saw the bed move laterally backwards and forwards. 5. ab. 30 secs. 6. pr. 5. 7. no.

2081. Do.—Mr. E. Phillips.* 3. ab. 5.25. 4. like the vibr. caused by a van passing. 5. ab. 5 secs. 7. a heavy van approaching; it came nearer and nearer, the rumbling becoming very great, and in receding died away quickly.

2082. *Chase Park*.—Mr. H. I. Weld.* 3. ab. 5.34. 4. a slight trem. upheaval of the bed; only one sh. 5. 10 to 15 secs. 6. pr. 5. 7. no.

2083. *Ealing*.—Mr. R. T. Lewis, F.R.M.S. 4. no sh. 'felt. 7. no.—“The whole of the pictures in my house which hang on the walls facing E. and W. . . were slightly displaced from the true horizontal position between the night of the 16th and morning of the 17th inst., each one being uniformly tilted so that the S. corners of the frame were $\frac{3}{8}$ inch higher than the N. corners. Pictures hanging one above the other on these walls, though similarly shifted, preserved their parallelism. The position of pictures hung upon the walls” facing N. and S. “was not perceptibly altered. I should say that my pictures are all hung on the plan suggested by Mr. Beeston, i.e. a cord is stretched across the back of the frame, and this is hitched over the head of a nail driven into the wall behind the picture, so that the means of suspension are concealed. Any lateral impulse acting for a given time will move a picture so hung more easily and through a larger arc than would be the case were it suspended by a long cord from a nail driven in near the cornice.”

2084. Do.—Mr. E. Prentice.* 3. 5.30. 4. the bed quivered and was then shaken vigorously.

2085. Do.—(c. by Mr. Maxwell T. Masters.) A lady on her knees, attending to a fire, felt a tendency to fall into it, as if she had been tilted from W. to E.

2086. Do.—(*Standard*, Dec. 18.) 3. shortly after 5.30. 6. in some

cases, crockery fell on the floor. 7. like a sudden rush of wind, f. by a low rumbling.

2087. *Ealing Dean*.—Mr. S. Spokea† 3. ab. 5.34. 4. a rolling motion. 6. 5.

2088. *Edgware*.—Mr. Judd † (*Daily Mail*, Dec. 18). 3. 5.35. 6. 5.

2089. *Enfield*.—Miss M. K. Sparke† 3. ab. 5.30. 4. the bed moved twice distinctly. g. E. to W. 6. pr. 5.

2090. Do.—Mr. W. S. Taylor† 3. bet. 5.30 and 5.45. 7. a heavy rumbling noise.

2091. *Finchley*.—Anon.* (*Daily Telegraph*, Dec. 18). 3. 5.34. 4. the bed vibrated 4 or 5 times with a slight rocking motion. g. S.E. to N.W. 5. ab. 3 secs. 6. 4 or 5.

2092. *Harrow-on-the-Hill*.—Mrs. Timmins† 4. the bed rocked several times. 6. 5. 7. no.

2093. Do.—Mr. W. H. Shaw† 4. only one sh. 5. 2 or 3 secs. 6. 5. 7. no.

2094. *Lower Edmonton*.—Mr. P. M. Bearey (Symons' *Meteor. Mag.* vol. 31, 1896, p. 179). 3. 5.35. 6. 4.

2095. *Mill Hill*.—Mrs. Burgess. 3. 5.34. 4. 2 shs, the second very slight. 5. ab. 3 secs. 6. 5.

2096. *Pinner*.—Miss A. E. Jeffreys. 3. 5.30. 5. 2 or 3 secs. 6. pr. 5. 7. an explosion.

2097. Do.—Mr. R. T. B. Vatcherley† 3. 5.35. 4. a vibr. of the entire room, f. by a rolling of the bed. 5. 3 to 4 secs. 6. 5. 7. no.

2098. Do.—Mr. F. H. Mabbett† (*Daily Telegraph*, Dec. 18). 3. 5.35. 4. 2 series. 6. pr. 4.

2099. Do.—Anon. (Do.). 3. ab. 5.35. 4. as if some one were underneath the bed, raising it and swaying it backwards and forwards. 5. several secs. 6. 5.

2100. *Rozeth*.—Miss M. A. Wilson.* 3. ab. 5.30. 5. ab. 2 secs. 7. no.

2101. *Southall*.—B. Oliver† 3. 5.30. 4. 2 shs, the second f. the first almost imm. 6. < 4.

2102. *Staines*.—Mr. J. Hamilton† 3. ab. 5.37. 4. as if a heavy train were passing. 5. 6 or 7 secs. 6. 5. 7. no.

2103. *Wealdstone*.—Anon.† 4. the bed lifted up twice sideways. 6. 5. 7. a loud noise acc. the first tremor, like a train rumbling under a tunnel or over an iron bridge.

HERTFORDSHIRE

2104. *Aldenham*.—(c. by Mr. H. G. Fordham.) 3. 5.35 A.M. 6. 5.

2105. Do., near.—E. Brunner† (c. by Mr. H. G. Fordham). 3. 5.30. 4. 2 shs, separated by an interval of 3 mins [*sic*]. 6. 5.

2106. *Ardeley Bury*.—M. J. Scott† 3. ab. 5.30. 4. the movement like that made by a very heavy goods-train. 5. 30 secs. 6. 5. 7. a very heavy goods-train passing. d. yes.

2107. *Ashwell*.—Mr. W. A. Fordham† 3. 5.35. 4. for a moment it seemed to the obs. as if he were in a berth on board a ship rolling heavily. 6. 5.

2108. *Baldock*.—Mr. J. R. Page. 3. 5.30. 4. 3 wave-like motions, right to left, left to right, and right to left. 5. ab. 2 secs each. 7. no.

2109. *Barkway*.—J. J. Balding (c. by Mr. H. G. Fordham). 4. the bed shook as if a traction-engine were passing.

2110. *Bayfordbury*.—Mr. W. Clinton Baker, F.R.Met.S.* 3. 5.32. 4. ab. 12 vibra. or more. d. the movement incr. in int. up to ab. the 9th vibr. and then died away. f. the oscillations were purely horizontal, a rocking motion. g. S.E. to N.W. 5. 15 secs. 6. 5. 7. no.

2111. *Bengeo*.—H. R. H. Gosselin (c. by Mr. H. G. Fordham). 3. ab. 5.30. 4. g. the bed (N.E. and S.W.) shook apparently from side to side, and the flaps at the end of a table (N.W. and S.E.) clattered while the sh. lasted. 6. pr. 5.

2112. *Berkhampstead*.—(c. by M. J. Willis) 6. 5.

2113. *Bishops Stortford*.—(c. by Rev. H. T. Lane) Sh. felt.

2114. *Bramfield*.—J. Salmon* (c. by Mr. H. G. Fordham). 3. ab. 5.30. 6. 5. 7. an unusual, indistinct and indescribable so. p., but did not f., the sh.

2115. *Braughing*.—(c. by Rev. P. G. Ward.) 3. ab. 5.30. 4. the bed shook considerably for some time.

2116. *Buckland*.—Mr. W. Jarman (c. by Mr. H. G. Fordham). 4, 7. first it was like a gust of wind, and then the house shook.

2117. *Cheshunt*.—Rev. F. F. Lambert† 3. 5.30. 4. a violent shaking of the bed. 6. 5.

2118. *Coles*.—L. R. Grey.* 4. the room heaved gently up and down. 6. pr. 5. 7. no.

2119. *Hatfield*.—Mr. C. Butler (c. by Mr. H. G. Fordham). 6. bottles piled up in the cellar were thrown down and strewed about the floor: they were all secure the night before.

2120. *Do.*—(*Standard*, Dec. 18.) "On the G. N. Railway, an engine-driver declared that after passing Hatfield the line practically rocked, and he feared that either the permanent way had subsided, or his train had become derailed."

2121. *Hawkshead*.—A. M. Dales.* 3. ab. 5.35. 4. d. yes. 6. 5. 7. an unusual rumbling so. b. p.

2122. *Heath*.—(c. by Mrs. S. Gifford Foulkes) 4. as if some one were walking across the room. 6. < 4.

2123. *Hemel Hempstead*.—(*Bucks Advertiser*, Aylesbury, Dec. 19.) 3. 5.30. 6. "the ceiling of the vestibule of the Town Hall was stripped bare to the plaster boards"

2124. *Hertford*.—Mr. W. P. Willson (*Hertfordshire Mercury*, Hertford, Dec. 19). 3. 5.35. 4. g. N. to S. 5. quite $\frac{1}{2}$ a min. 6. 5.

2125. *Do.*—Mr. L. McMullen (Do.). 3. 5.35. 6. pr. 5.

2126. *Hertingfordbury*.—Mr. W. E. Topham† (Do.). 3. 5.30. 6. 5.

2127. *High Barnet*.—Mr. Hedland† (*Daily Mail*, Dec. 18). 3. ab. 5.30. 6. 5.

2128. *Hitchin*.—Mr. W. Hill, F.G.S.* 3. 5.34. 4. 3 main half-vibra,

to north, to south, and back to north; very distinct and easy movements, neither jerky nor violent. f. no. 5. 2 or 3 secs. 6. 5. 7. no.

2129. Do.—Miss G. Lucas † (c. by Mr. H. G. Fordham). 3. ab. 5.30. 4. the bed rocked. 6. 5; in the morning, two cracks were discovered in the dining-room walls, extending from floor to ceiling; the room had been enlarged ten years before and it was pr. a weak place in the building. 7. another obs. heard a prolonged noise, as of plaster and bricks falling.

2130. Do.—Mr. W. Ransome * (*Hertfordshire Express*, Hitchin, Dec. 19). 3. 5.40. 4. the motion very similar to that experienced when driving in a carriage over a depression in the road; imm. afterwards the two windows in the room shook. 6. pr. 5. 7. a noise resembling the discharge of a distant fog-signal f. the sh.

2131. *Kensworth*.—Miss S. G. Jones (c. by Mr. H. G. Fordham). 3. 5.35. 4. a sharp sh. 6. < 4.

2132. *Leavesden Green*.—E. Peach. † 3. ab. 5.30. 4. the bed rocked backwards and forwards. 6. 5.

2133. *Little Berkhamstead*.—(c. by Rev. G. Gibson.) 4. the sh. felt, but only slightly.

2134. *Little Gaddesden*.—Fräulein M. A. Haftstein. 3. 5.30. 5. 2 or 3 secs. 6. 5; cupboard doors were thrown open, although certainly locked. 7. a rumbling noise before the sh., the interval bet. them being 1 or 2 secs.; a noise, like that of a traction-engine moving heavily along, f. the sh. by a few secs.

2135. *Little Mill*.—(c. by Mr. J. Hopkinson.) 4. sh. felt. 7. a rumbling noise p. the sh.

2136. *Luffenhall*.—Anon.* (c. by Mr. H. G. Fordham). 3. ab. 5.35. 4. the sh. consisted of 2 distinct parts, if not 3, with an interval of a few secs., the second pr. the stronger. 6. 5. 7. no.

2137. *Markyate*.—(*Leighton Buzzard Observer*, Dec. 22.) 4. sh. felt.

2138. *Moor Hall* (near Ardeley).—Miss M. H. Young and Mrs. Wright. 3. 5.30. 4. no interval noticed. g. S.E. to N.W. 5. 3 or 4 secs. 6. 5. 7. birds in the chimney. b. p.

2139. *Nash Mills*.—Sir J. Evans, LL.D., F.R.S., etc. † 3. ab. 5.45. 4. a slight rocking of the bed. 7. an explosion at a little distance.

2140. *New Barnet*.—Mr. H. E. Penman. † 3. ab. 5.30. 4. the bed swung slightly from side to side, like the rocking of a cradle. 5. 4 or 5 secs. 6. 5. 7. two distinct noises, a few secs. apart, the second pr. the louder.

2141. Do.—Mrs. Fryer and A. E. Coles † (c. by Mr. H. G. Fordham). 3. ab. 5.27 or 5.30. 4. the beds rocked with a decided movement from E. to W.; this was f. by a sort of creaking of the outer wall as after a severe strain. 5. > 3 or 4 secs. 6. 5. 7. a noise as of heavy pictures or furniture falling in the room below.

2142. *Pirton*.—Anon.* (c. by Mr. H. G. Fordham). 4. the bed rocked from E. to W. 6. 5; in a neighbouring cottage, the clock (facing due N.) on the mantelpiece was stopped, and a vase on the W. side of the clock was found leaning against it. 7. an apparently distant so. was heard directly after the sh.

2143. *Redbournbury*.—Mr. E. W. Arnold (c. by Mr. J. Hopkinson,

F.G.S.). 3. 5.35. 4. a. a slight tremor, ab. $\frac{1}{2}$ min. b. a double movement of the bed, first up and then down. g. ab. N.N.W. to S.S.E. 6. 5. 7. one or two persons heard a noise.

2144. *Reed*.—Mr. J. Wilson (c. by Mr. H. G. Fordham). 3. ab. 5.35. 4. the bed rocked from N. to S. very distinctly. 5. 3 or 4 secs. 6. 5.

2145. *Rickmansworth*.—Rev. A. E. Northey.† 3. 5.25. 4. the obs. believes that he was awakened by the first and slighter of two sha. 6. pr. 5; in several houses in the town, crockery was thrown down. 7. no so., except that of a concussion, as if some huge van or traction-engine had been overturned in the street close by.

2146. *Do*.—Mrs. C. Fry* (c. by Mr. H. G. Fordham). 3. 5.30. 4. a very gentle trembling of the bed; this was repeated, then a third time, and imm. it seemed as if some one had raised the bed and tried to twist it. 6. 5.

2147. *Rothamsted Lodge*.—Lt.-Col. E. Durnford. 3. ab. 5.34. 4. 2 sha., the first a shaking as if a heavy vehicle were passing close; the second, a few secs. afterwards, consisting at first of undulatory shakes f. by an upheaval, the bed feeling as if lifted 3 or 4 inches. 5. duration of the second sh. ab. 5 secs. 6. 5; the ceiling was cracked in a room built over the porch (outside the main wall of the house), and a pane of glass in the conservatory was cracked. 7. no; but another obs. heard a noise before the sha. as of something falling.

2148. *Royston*.—Mrs. Hughes† (c. by Mr. H. G. Fordham). 3. ab. 5.30. 6. 4. 7. awakened by a peculiar rumbling and grating so. wh. appeared to come from the S.W. b. p.

2149. *St. Albans*.—Mr. J. Hopkinson, F.G.S. "My friend Mr. . . . told me that he found most of the pictures hanging on the walls of his house out of position after the shock; . . . I ascertained that the pictures on the east and west walls were more disturbed than those on the north and south walls, that they were on the average half an inch out of position, and that most of them were raised on the east and lowered on the west. I then looked at mine and found that in my dining-room all the lighter pictures on the east and west walls were slightly raised on the east, some being quite half an inch out of square and others rather less. On the same walls there is one very heavy picture which remained in its proper position, and so did all on the north and south walls. I feel sure that all were horizontal on the previous day. They are oil-paintings and heavier than the water-colours in my drawing-room. These also were askew on all the walls, but with no regularity, which I attribute to the fact that they more easily swing backwards and forwards." Mr. Hopkinson adds, "For E. and W. walls I should have said E.S.E. and W.N.W. true (=S.E. and N.W. magnetic nearly). Mr. —'s house is to the S.E. of mine . . ., and is about 50 feet lower. It is more nearly true N. and S. It is modern and thinly built, while mine is 180 years old and has one inner wall two feet thick."

2150. *Do*.—Miss Eleanor A. Ormerod, F.E.S.* 3. 5.30. 4. the vibrs. were apparently all similar, they began and ended suddenly; the movement as if some one held one end of the upright frame of the bed and shook it to and fro. f. no. 5. ab. 15 secs. 6. 5. 7. no.

2151. *Do*.—(c. by Mr. J. Hopkinson.) 3. 5.35. 4. the movement of

the bed at first as if a man were walking across the room, and then the bed went up and down.

2152. Do.—(*Standard*, Dec. 18.) 6. 5.

2153. *Sandon Bury*.—Mr. W. H. Lees * (c. by Mr. H. G. Fordham). 3. ab. 5.35. 7. a rushing mighty wind with a sound like boys with hob-nailed shoes sliding on rough ice; the so. went from W. to E.

2154. *Stevenage*.—Mr. W. B. Rooke. 3. ab. 5.25. 4. only one sh. 6. 5. 7. a loud rumbling like a heavy train passing.

2155. Do.—Mr. C. Mordell † (c. by Mr. H. G. Fordham). 3. ab. 5.30. 4. awakened by a violent shaking of the bed. 6. pr. 5.

2156. *Theobalds*.—(c. by E. M. Gower.) 3. ab. 5.35. 4. 2 shs. with scarcely any interval, the bed was raised twice. 6. 5. 7. no.

2157. *Therfield*.—(*Herts and Cambs Reporter*, Dec. 25.) 4. as if some one had hold of the bed and was shaking it. 6. 5. 7. horses kicking in an adjoining stable.

2158. *Tring*.—Mrs. S. Gifford Foulkes † 3. some time after 5. 4. sh. felt.

2159. Do.—(c. by Mrs. S. Gifford Foulkes.) 6. pr. 5.

2160. *Ware*.—(*Hertfordshire Mercury*, Hertford, Dec. 19.) 3. 5.35. 4. sh. felt.

2161. *Watford*.—Mr. G. H. Haywood † 3. bet. 5.33 and 5.34. 4. a regular succession of waves, ab. 3 to the sec. g. W.S.W. to E.N.E. 5. 4 to 6 secs. 6. one picture was slightly tilted. 7. no.

2162. Do.—Mr. S. Martin † (c. by Mr. H. G. Fordham). 3. ab. 5.25. 4. the bed heaved perceptibly, the sensation being that a wave had passed under it. 6. 5; the doors of a large wardrobe swung open.

2163. Do.—Mrs. A. King Smith * (Do.). 3. ab. 5.30. 4. heard first a sort of thud, and then directly after the brass (hanging) handles of the bedroom furniture rattled noisily; no movement felt.

2164. Do.—Prof. J. Attfield, F.R.S. * (*Times*, Dec. 18). 3. 5.34. 4. the first effect noticed was the noisy vibr. of a nearly empty 150-gallon cistern on the second floor; this was f., within 10 secs., by the moderate rattling of the window-sashes in the bedroom; the whole house shook slightly. 5. 20 secs. 6. 4.

2165. *Watton*.—Mr. A. H. Smith † (c. by Mr. H. G. Fordham). 5. a few secs. 6. 4.

2166. *Woodside* (near Leavesden).—Mr. K. Kentish (Do.). 3. ab. 5.30. 6. 5.

BEDFORDSHIRE

2167. *Amphill*.—Mr. C. M. N. Rushforth * 3. bet. 5.30 and 6 A.M. 4. the movement grad. and continuously incr. in int. from beg. to end. f. no. 5. < 5 secs. 6. pr. 5. 7. no.

2168. *Aspley Guise*.—(*Leighton Buzzard Observer*, Dec. 22.) 6. in a large number of cases, glass and crockery were thrown down.

2169. *Barton-in-the-Clay*.—Mr. H. Ward. 3. 5.34. 4. sh. felt; it set the mill in motion.

2170. *Bedford*.—Mr. C. F. G. Hervey.† 3. ab. 5.28. 4. g. E. to W. 6. pr. 5. 7. no.
2171. *Do*.—Mr. S. M. Herbert. 3. bet. 5.30 and 6. 4. 2 series of tremors. 6. 4. 7. as if the wind were rising outside.
2172. *Do*.—(*Nottingham Express*, Dec. 19.) 3. ab. 5.35. 4. g. S.W. to N.E. 6. pr. 5. 7. a hollow rumbling so.
2173. *Do*.—"F. C. M." (*Daily News*, Dec. 19.) 3. bet. 5 and 6. 4. sh. felt. 7. a loud rumbling noise.
2174. *Biggleswade*.—Mr. W. Chambers. 3. ab. 4.30 [*sic*]. 6. pr. 5. 7. a railway-train passing.
2175. *Do*.—(*Hertfordshire Express*, Hitchin, Dec. 26.) 3. 5.30. 4. the sh. distinctly felt. 6. pr. 5.
2176. *Dunstable*.—(*Leighton Buzzard Observer*, Dec. 22.) 4. sh. felt.
2177. *Eaton Bray*.—Miss L. Wedge.† 3. 5.34. 4. 2 distinct shs.; each time the bed was shaken violently from side to side and lifted up. 6. 5.
2178. *Eaton Socon*.—(c. by E. R. Peppercorn.) 4. the sh. consisted of 2 distinct parts, separated by an interval of 1 or 2 secs, the first part much the stronger. 5. ab. 5 secs. 6. pr. 5. 7. no.
2179. *Harrold*.—Mr. C. Le Tevre, jun. 3. 5.25. 4. a slight trembling at first, wh. grad. incr. 5. ab. 30 secs. 6. 4. 7. a strong wind.
2180. *Leighton Buzzard*.—Anon.† 3. 5.35. 4. the sh. consisted of 2 parts; the first a violent shaking of the bed from S. to N.; then, after an interval of a few secs, the second part, much slighter, movement from E. to W. 5. ab. 4 secs. 6. pr. 5. 7. no.
2181. *Linslade*.—(*Leighton Buzzard Observer*, Dec. 22.) 6. 4.
2182. *Luton*.—Mr. E. M. Williams. 3. 5.36. 5. 18 to 20 secs. 6. 5 or 6. 7. a heavily-laden cart travelling at a rapid pace over a rough road; but, as the so. reached the house, it appeared to cease; the so. c. with the sh. (Others compared the so. to a violent gust of wind.)
2183. *Do*.—Mr. M. Barford (*Daily Telegraph*, Dec. 18.) 3. bet. 5.40 and 5.45. 4. 2 or 3 distinct shs. 6. 5.
2184. *Do*.—(*Leighton Buzzard Observer*, Dec. 22.) 6. in some parts of the town, plaster fell from ceilings. 7. a policeman on duty heard a so. like a gust of wind.
2185. *Potton*.—Anon.† 3. ab. 5.40. 6. 4.
2186. *Sharnbrook*.—Mr. M. Stileman-Gebhard.† 3. bet. 5 and 6. 5. 1 or 2 secs. 7. a few secs. after the sh., there was a so. as of a heavy carriage at a little distance.
2187. *Woburn*.—(*Leighton Buzzard Observer*, Dec. 22.) 6. at one house, water was spilt from a jug standing on a wash-stand.
2188. *Woburn Sands*.—Mr. H. B. Mallam.† 3. 5.36. 4. 2 shs, the second f. the first imm., then an upward trem. mot. g. N. to S. 5. 6 secs. 6. pr. 5. 7. the explosion of gunpowder in a pit. b. p.

BUCKINGHAMSHIRE

2189. *Amersham*.—Rev. E. T. Drake.† 6. < 5; a lot of bricks were shaken down from the inside of one of the chimneys; the grates in two

other rooms were loosened. 7. a rumbling noise, like the fall of some heavy body.

2190. Do.—(*Bucks Herald*, Aylesbury, Dec. 19.) 6. 5.

2191. *Ashley Green*.—Mrs. Ross Barker. 3. 5.32 A.M. 4. an undulatory motion, very like being in a small boat in the swell of a large steamer; there were 3 equal undulations, and the 4th and last was more of a swing; they were all smooth and free from jerk. g. N. and S. 5. 4 to 5 secs. 6. 5 or 6; a stuffed flying-fish suspended by a string round its tail to the door of a wardrobe swayed to and fro in time with the wave, bumping against the wood between each swing. 7. when the sh. was over, the obs. sat up and removed a shawl from over her ears, and heard a sort of long moan or grumbling dying away.

2192. *Aston Clinton*.—Anon.† (c. by Rev. T. Williams). 3. 5.35 to 5.40. 5. instantaneous. 6. < 4. 7. no.

2193. *Aston-Sandford*.—Rev. E. S. Elwell, D.D.† 3. ab. 5.40. 4. only one sh.

2194. *Aylesbury*.—(*Bucks Advertiser*, Aylesbury, Dec. 19.) 3. ab. 5.30. 4. the vibr. like that made by a heavy traction-engine or steam-roller passing along the street. 6. pr. 5.

2195. Do.—(Do.) 3. 5.15 or 5.30. 6. in several houses small articles were disturbed.

2196. *Beaconsfield*.—"E. H."† (*Daily Telegraph*, Dec. 18). 3. 5.38. 6. 5.

2197. *Buckingham*.—Rev. F. G. Kiddle.† 4. the bed rocked from side to side. 6. 5. 7. as though heavy furniture were being moved in the room below.

2198. *Chesham*.—Mr. F. Churchill† and Mr. J. Smith.† 3. 5.35. 4. 3 or 4 vibrs. f. yea. 5. 2 to 3 secs. 6. 5. 7. a heavy goods-train. b. f. 1 sec. c. f. 4 secs. d. yea. e. f. 2 secs. f. no.

2199. Do.—(*Bucks Herald*, Aylesbury, Dec. 19.) 3. 5.30. 5. fully 20 secs. 6. 5; in some cases crockery, etc., was broken. 7. a rumbling so.

2200. *Chilton*.—Rev. J. B. Tyson. 3. ab. 5.30. 4. g. E. to W. 6. 5.

2201. *Colnbrook*.—Anon.† (c. by Rev. F. P. Burnett). 3. 4.30 [*sic*]. 5. ab. 2 secs. 6. 5. 7. another obs. heard before the sh. a loud rumbling noise, as if the mail-van had dashed against the corner of the house.

2202. *Cresser*.—Mr. W. Morris* (c. by Mr. C. J. Barnett). 3. 5.32. 5. 3 or 4 secs. 7. a so. like the banging of a door, but more muffled.

2203. *Eton*.—Mr. A. Heygate. 3. just after 5.30. 4. a lateral movement, apparently continuous. g. N. and S. 5. pr. 10 secs. 6. 5. 7. a very heavy traction-engine passing. b. f. 3 or 4 secs. c. c.

2204. *Farnham Royal*.—Mr. F. C. Carr-Gomm. 3. 5.35. 4. a double wave. 5. ab. 1½ secs. 6. 5. 7. no.

2205. *Fulmer*.—Mr. C. B. Foster. 3. ab. 5.42. 4. a rocking motion. 5. ab. 2 secs. 6. 5. 7. no.

2206. *Great Marlow*.—A. M. F. Whittingstall.† 3. 5.30. 4. one series of vibrs. 5. 10 secs. 6. pr. 5. 7. yea.

2207. Do.—(*Bucks Herald*, Aylesbury, Dec. 19.) 4. a most unpleasant oscillating movement. 5. 6 or 7 secs. 6. pr. 5. 7. a distinct noise, f. by a violent vibr.

2208. *Great Missenden*.—(c. by Rev. W. L. Wilson.) 4. the sensation was as if some one under the bed were lifting it up. 6. 5.

2209. *Grendon Underwood*.—Rev. R. H. Pigott. 4. the bed trembled. 5. ab. 5 secs.

2210. *Haddenham*.—Mr. E. J. Bishop.* 3. ab. 5.32 or 5.33. 4. as if the bed were lifted up an inch or two twice, the second lift closely following the first; imm. afterwards a slight rattling of the windows. 5. bet. 3 or 4 secs. 6. 5. 7. a rumbling so. heard by others.

2211. *Hampsteadon*.—(*Henley Advertiser*, Dec. 19.) 6. a clock was stopped.

2212. *Haslemere*.—Mrs. Burke.† 3. ab. 5.35. 4. a severe trembling, not a rocking motion. 5. ab. 7 secs. 6. 5. 7. a dull heavy rumble wh. incr. in volume until the bed began to shake, together with a rushing swirling so.; the sounds were lost or not noticed so much while the furniture, etc., rattled.

2213. *Do*.—Major Powell (*Bucks Herald*, Aylesbury, Dec. 19.) 3. 5.35. 5. 5 or 6 secs. 6. pr. 5.

2214. *Hedgerley*.—E. E. Stevenson.† 3. bet. 5.30 and 5.35. 6. a stone cross was thrown over, and another small marble was twisted on its base and moved more than an inch from N. to S. 7. a rumbling noise was heard by one obs.

2215. *High Wycombe*.—Mr. S. Haig (*South Bucks Free Press*, High Wycombe, Dec. 18.) 3. 5.34. 4. g. W. (slightly by S.) to E. 5. 4 or 5 secs. 6. pr. 5. 7. a premonitory rumbling.

2216. *Do*.—(*Bucks Advertiser*, Aylesbury, Dec. 19.) 6. 5; those who were up say that a distinct tremor of the ground was observable and buildings shook perceptibly.

2217. *Iver*.—Mr. B. J. Noble.† 3. bet. 5.30 and 5.40. 4. one series. 5. ab. 7 or 8 secs. 6. 5. 7. no.

2218. *Do*.—(c. by Mr. B. J. Noble.) 5. 7 or 8 secs. 6. < 4.

2219. *Little Marlow*.—Miss R. Carter (c. by Rev. A. I. Thompson). 3. 5.40 to 5.45. 4. only one sh. d. yes. e. end. 5. ab. 30 secs. 6. < 5; an extensive crack was made, removing plaster and breaking the wall back from an inserted cupboard in the kitchen. 7. a rumbling so., app. passing northwards and ending in the crackling noise often heard with thunder; a hissing noise was also heard (possibly connected with the disturbance of the plaster passing upwards) not unlike the so. of a strong wind through a key-hole or window-crack. c. f. ab. 1 sec.

2220. *Little Missenden*.—Anon.† (*Daily News*, Dec. 18.) 3. ab. 5.20. 6. < 4. 7. falling masonry (others in the house heard nothing).

2221. *Ludgarshall*.—Rev. F. F. Morgan. 3. 5.32. 4. 3 distinct vibra., lasting ab. a sec. each. 7. no.

2222. *Newport Pagnell*.—Rev. H. H. D. Bolton. 3. ab. 5.35. 4. a. no. b. ab. 6 prominent vibra. c. no. d. yes, one series. e. mid. f. yes. 5. ab. 3 secs. 6. 5; in some houses pictures were disturbed.

2223. *Do*.—(c. by Rev. J. P. Langley.) 6. books were shaken off a shelf at the station.

2224. *North Marston*.—Anon.† (*Bucks Advertiser*, Aylesbury, Dec. 19.) 3. bet. 5 and 6. 6. pr. 5.

2225. *Olney*.—(c. by Rev. J. P. Langley.) 6. pr. 5. ;

2226. *Over Winchendon*.—(c. by Rev. T. J. Williams) 6. 5. 7. the sh. was p. by a rumbling so.

2227. *Padbury*.—(c. by Mr. C. V. Norman) 3. 5.28. 4. like a wave advancing from W. to E. 6. 5.

2228. *Penn.*—Mr. G. E. Larkin. 3. 5.37. 4. a slight upheaval of the bed and a waving sensation: "I am under the impression there were two shocks, the second much the stronger." g. S.W. to N.E. 5. 15 to 20 secs. 6. 5. 7. a rushing mighty wind. b. p. ab. 2 or 3 secs. c. c.

2229. *Princes Risborough*.—(c. by Rev. R. R. Bardolph) 3. 5.30. 4. ab. 8 or 9 vibra., increasing in int. and stopping suddenly. e. end. f. yes. 5. 4 secs. 6. 5. 7. a low rumbling like distant thunder.

2230. *Quinton*.—(*Bucks Herald*, Aylesbury, Dec. 19.) 3. ab. 5.30. 4. sh. felt.

2231. *Roughwood Farm* (near Chalfont St. Giles).—Col. P. FitzG. Galloway, R.A.† 3. 5.34. 4. an undulating sh. g. W. to E. 5. ab. 3 secs. 6. pr. 5. 7. no.

2232. *Slough*.—Anon. 3. ab. 5.35. 4. 4 or 5 rapid vibra. f. yes (others in the house said their beds rocked). 5. ab. 3 or 4 secs. 6. 5. 7. a rumbling noise, as if the chimney were coming down; the beg. of the sh. f. the end of the so. almost imm.

2233. *Steeple Clayton*.—Rev. Ll. J. Kenyon-Stow.† 3. ab. 5.30. 6. 5.

2234. *Stone*.—Rev. J. L. Challis† (c. by Rev. C. Dowding). 6. bet. 5 and 30 secs. 7. a rumbling heard by another obs.

2235. *Taplow*.—(c. by Mr. J. Rutland, F.G.S.) 3. ab. 5.35. 4. g. N. and S. 6. 5. 7. a rumbling noise.

2236. *Thame*.—(*Bucks Advertiser*, Aylesbury, Dec. 19.) 3. shortly before 6. 6. 5.

2237. *Waddesdon*.—Anon.† (c. by Rev. T. J. Williams). 3. ab. 5.30. 4. as if some one were underneath, moving the bed. 6. 5. 7. the sh. was p. by a rumbling so.

2238. *Wendover*.—(*Bucks Advertiser*, Aylesbury, Dec. 19.) 3. ab. 5.30. 6. pr. 5. 7. a rumbling noise.

2239. *Whitchurch*.—(c. by Rev. G. T. Medd.) 3. ab. 5.30. 4. a quiet undulating or rocking motion. 5. a few secs. 6. 5.

2240. *Windsor*.—(*Bucks Advertiser*, Aylesbury, Dec. 19.) 3. ab. 5.30. 5. several secs. 6. 5.

2241. *Wycombe Abbey*.—Miss A. R. Burne.† 4. the bed trembled violently. 6. < 4.

HUNTINGDONSHIRE

2242. *Diddington*.—Mrs. King* (c. by Rev. A. Hannan). 3. ab. 5.30 A.M. 7. a passing traction-engine.

2243. *Huntingdon*.—The Ven. Archdeacon F. G. Vesey.* 3. shortly after 5.30. 4. a trem. mot. like that made by the passing of a traction-engine. f. no. 5. ab. 30 secs. 6. < 4. 7. no.

2244. *Do.*—(*Cambridge Independent Press*, Dec. 24.) 4. sh. felt, but not very markedly. 7. several persons were awakened by the noise.

2245. *Norman Cross*.—Mr. N. Allen.* 3. ab. 5.35. 4. a distinct upheaval f. by a corresponding subsidence. 5. ab. 2 secs. 6. 5. 7. no.

2246. *Pidley*.—Mr. D. F. Haines. 3. 5.40. 6. 4. 7. so. heard.

2247. *Ramsey*.—Mr. A. J. C. Rose.† 3. ab. 5.40. 4. d. yes. e. mid. 5. ab. 10 secs. 6. pr. 5. 7. 2 or 3 traction-engines coming quickly down the street; the so. came from the S.W. b. f. 2 or 3 secs. c. p.

2248. *St. Ives*.—Anon.* (c. by Rev. S. J. M. Pim). 4. the bed seemed to move.

2249. *Wistow*.—S. de la Pryme. 3. bet. 5.30 and 5.40. 6. 4. 7. the rumble of a traction-engine.

CAMBRIDGESHIRE

2250. *Benwick*.—Mr. H. Anderson. 4. the bed quivered. 5. some secs.

2251. *Boxworth*.—Mr. E. A. Thornhill.* 3. 5.35 A.M. 4. the bed shook 3 times. 5. ab. $\frac{1}{2}$ sec. 7. no so. heard. ("A labouring man coming from an adjoining village to work here said he heard a noise and felt the shock twice at an interval of about $1\frac{1}{2}$ minutes.")

2252. *Cambridge*.—Mr. H. Pain.* 3. bet. 5.34 $\frac{1}{2}$ and 5.35. 4. a rocking motion repeated 5 or 6 times. 5. ab. 10 secs. 6. 5. 7. no.

2253. *Do.*—Col. Caldwell.* 3. bet. 5.20 and 5.25. 4. the bed rocked gently and pleasantly from side to side, i.e. N. and S. 5. 8 to 10 secs. 6. pr. 5. 7. a rumbling or rushing so. before the sh.; not noticed after the bed began to rock.

2254. *Ely*.—Lady Alwyne Compton (*Times*, Dec. 19). 3. 5.30. 4. the motion was a rocking, not a quick vibr.

2255. *Grantchester*.—C. Waltham.† 4. a peculiar motion of the bed. 5. ab. 2 secs. 6. pr. 5. 7. no.

2256. *Thorney*.—Mrs. Hurry* (c. by Mr. J. W. Bodger). 3. 5.33. 4. a rocking motion, as though in a boat. 5. ab. 2 secs. 6. pr. 5. 7. no.

2257. *Whittlesford*.—A. Barker.* 3. ab. 5.35. 4. the bed shook distinctly with a swinging motion. 5. ab. 2 secs. 6. 5? 7. no.

2258. *Wisbech*.—Miss A. Peckover. 3. ab. 5.30. 4. g. W. to E. 6. 5? 7. a curious rushing so.

2259. *Do.*—Anon. 4. sh. felt. 7. a rumbling noise heard.

ESSEX

2260. *Berden*.—Anon.† (c. by Mr. W. Lucking). 3. 5.30 A.M. 4. a very perceptible shaking of the bed. 6. 5?

2261. *Brentwood*.—Mr. F. Landon* (c. by Mr. W. Cole). 3. 5.35. 4. no sh. felt; the jug rattled 3 or 4 times, and again 3 or 4 times after an interval of 2 or 3 secs.

2262. *Bulmer*.—Miss M. A. Burke.* 3. bet. 5.30 and 5.35. 4. f. yes. 5. pr. < 1 min. 6. 5. 7. a little while after the sh. there was a faint rushing so.

2263. *Chigwell*.—Mrs. Mildred.† 3. 5.30. 6. pr. 5

2264. *Colchester*.—Anon.* 3. bet. 5.15 and 5.45. 6. pr. 5. 7. no.
2265. *Dagnams*.—Mrs. Sands† 4. 2 shs, the second f. the first imm. 7. no.
2266. *Heydon*.—(c. by Mrs. A. Savile.) 3. 5.35. 6. pr. 5. 7. noise heard.
2267. *Ingrava*.—(c. by Rev. H. D. Heatley.) 6. < 4.
2268. *Do*.—Anon.* (Do.) 3. bet. 5.30 and 5.45. 6. a lamp hanging from the ceiling shook. 7. a heavy railway train.
2269. *Kelvedon*.—M. Fuller. 4. one heave of the bed. 6. pr. 5.
2270. *Little Yeldham*.—(c. by Mr. S. K. Death.) 3. 5.30. 6. < 4.
2271. *Loughton*.—Mr. J. Cubitt. 3. ab. 5.30. 4. a rapid and forcible shaking of the bed, at the rate of from 3 to 5 times a sec., the bed being apparently moved an inch or two. g. N.E. and S.W. 5. 5 or 6 secs. 6. 5. 7. no.
2272. *Maldon*.—A. Moss† 3. ab. 5.30. 4. strong tremors from E. to W.; the sh. pr. consisted of 2 parts, separated by a few secs. 5. ab. 4 secs.
2273. *Springfield* (near Chelmsford).—Miss M. S. Holgate† 3. 5.45. 4. the walls of the house appeared to be undulating and the bed also; a piece of china on the mantelpiece knocked against the wall, and the rate of knocking (afterwards tested by the metronome) appeared to be about 184 per minute. g. N.E. to S.W. 6. pr. 5.

SUFFOLK

2274. *Bury St. Edmunds*.—Miss E. F. Babington† 3. ab. 5.30 or 5.35. 4. the motion something like that caused by an underground railway-train in a building imm. over it, but with more of a roll. 5. ab. 4 or 5 secs. 6. 5? 7. after the sh. was over, the obs. thought she heard a so. as of trees rustling, but there was no wind.
2275. *Do*.—Mrs. H. Guy. 3. 5.34. 4. a rocking motion. 5. 5 or 6 secs. 7. no.
2276. *Do*.—(*Standard*, Dec. 21.) 4. a rocking motion. 6. < 4.
2277. *Rumburgh*.—(c. by Rev. W. L. Wilson.) One person, who sleeps lightly, felt and heard the eq.

NORFOLK

2278. *East Dereham*.—J. Wright.* 3. ab. 5.35 A.M. 4. the bed shook, or rather heaved. 7. no so. heard.
2279. *King's Lynn*.—Anon.* 3. ab. 5.30. 7. a loud rumbling noise, like a traction-engine passing, but lasting longer, and ceasing suddenly.
2280. *Necton*.—(c. by Mr. R. H. Mason.) 4. a shaking of the whole room, f. almost directly afterwards by another shaking.
2281. *Do*.—Mr. R. H. Mason.* Observed neither sh. nor so., but heard the fall of something in the passage. "On inquiry afterwards, I found that two iron rods and the handle for pumping the organ, which were resting in the first-floor passage, had fallen forwards. As the floor is of polished wood, very little would have knocked them down."

2282. *Norwich*.—A. M. Barnard.† 4. the bed shook and moved as though some one were underneath; shortly afterwards there was a second wave much weaker and shorter, not lasting more than 2 sec. 7. a very loud rumbling as if a carriage were going hurriedly by. (Several persons in Norwich were wakened by what they thought were traction-engines passing.)

2283. *Do.*—Miss A. M. Brown.* 3. 5.35 or 5.36. 4. 2 or 3 beats or gentle movements of the bed. 5. ab. 3 or 4 sec. 6. pr. 4. 7. no.

NORTHAMPTONSHIRE

2284. *Aynho*.—Mr. W. Walklett.* 3. 5.35½. 4. 5 distinct upward movements, the third being the most violent, f. by a swinging motion, N. and S., commencing slightly and increasing, the second and third swings being more violent than the others, then ab. 4 or 5 violent swings; this was f. by a very sharp quivering sensation which lasted quite 5 or 6 sec. 5. 16 sec. 6. 5. 7. no.

2285. *Benefield*.—K. A. Chataway.† 3. ab. 5.30. 5. 2 or 3 sec. 6. 5. 7. no.

2286. *Do.*—(c. by K. A. Chataway.) 3. 5.30. 6. 5. 7. a rushing wind, lasting ab. 2 sec.

2287. *Blisworth*.—(*Northampton Herald*, Dec. 19.) 3. 5.34. 6. 5.

2288. *Boughton*.—Mr. T. H. Warren † (Do.) 3. bet. 5 and 6. 6. 5.

2289. *Brackley*.—Mr. H. Bedford.* 3. 5.35. 4. g. W. to E. 5. ab. 5 sec. 6. 4. 7. a traction-engine passing rapidly. b. c. ab. c. f. ab. 5 sec.

2290. *Briworth*.—Mr. G. Walker.* 3. 5.35. 4. the bed gave a lurch as if some one shoved it. 6. 5. 7. a passing train. b. p. 10 sec.

2291. *Do.*—Mr. U. Bevan.* 3. 5.35. 4. the sh. in two parts, the first stronger. 5. ab. 20 sec. 6. pr. 5. 7. the rumbling of a train.

2292. *Burton Latimer*.—Miss A. Harper.* 3. ab. 5.40. 4. the bed moved from S. to N., and, as there was a light in the room, the bed was seen to heave up on the S. side; then came a trem. mot. 6. 5. 7. underground thunder. b. p.

2293. *Do.*—(*Kettering Leader*, Dec. 18.) b. pr. 5. 7. the sh. was acc. by a distinct rumbling noise.

2294. *Creton*.—(*Northampton Herald*, Dec. 19.) 3. 5.33. 6. 5.

2295. *Dallington*.—(c. by Miss L. N. Beasley.) 3. pr. 5.34. 4. a rocking of the bed from side to side; 2 or 3 vibra. g. S.W. to N.E. 5. ab. 2 sec. 6. 5. 7. a thumping or banging so.

2296. *Daventry*.—(*Daventry Express*, Dec. 19.) 3. bet. 5 and 6. 6. 5.

2297. *Desborough*.—Mr. F. C. Fenton (*Northampton Herald*, Dec. 19.) 3. ab. 5.38. 5. at least 25 sec. 6. 5. 7. a so. as of distant thunder, f. by a tremor.

2298. *Duddington*.—(c. by Mr. F. Coventry.) 3. 5.30. 6. < 5. 7. a rumbling, like that of a traction-engine, p. the sh.

2299. *Eye*.—Miss Targwell † (c. by Mr. J. W. Bodger.) 4. a vert. mot., 3 times. 5. 15 sec. 6. 5.

2300. *Guildenburgh*.—(*Northampton Herald*, Dec. 19.) 3. ab. 5.30. 6. 5; in one house, crockery was shaken down and broken. 7. a lumbering noise, like the rolling of distant thunder.

2301. *Hardingstone*.—(Do.) 6. crockery and other things were shaken off shelves.

2302. *Harpole*.—Mr. E. Scriven † (*Kettering Leader*, Dec. 18.) 3. ab. 5.30. 4. an undulatory movement of the bed. 5. several secs. 6. 5? 7. the sh. was imm. f. by a rather loud and prolonged, but subdued, rumbling noise, like the passage of a heavily-laden vehicle over a hard-frosted road.

2303. *Higham Ferrers*.—(*Northampton Herald*, Dec. 19.) 3. ab. 5.35. 4. sh. felt.

2304. *Isham*.—(*Kettering Leader*, Dec. 18.) 3. ab. 5.30. 4. a well-marked trembling.

2305. *Kettering*.—Mr. C. W. Lane.* 3. bet. 5.34 and 5.35. 4. 2 series of vibra., separated by an interval of 3 or 4 secs., the first being the longer and more intense. f. no. 5. first series, 10 secs., second 6 secs.; total 20 secs. 6. 5. 7. a rumble, as of a traction-engine passing at a short distance, f. the first series in 3 or 4 secs. d. yes.

2306. Do.—(*Kettering Leader*, Dec. 18.) 4. two shs., the second shortly after the first. 6. 5. 7. a peculiar rumbling grating noise.

2307. *King's Sutton*.—M. E. Hunt.† 3. ab. 5.30. 4. the bed oscillated as if a strong person had taken hold of the foot and shaken the bed. g. E. to W. 5. several secs. 6. 5. 7. a train in the distance. c. p. some secs.

2308. Do.—(c. by M. E. Hunt.) 6. < 4. 7. a heavy miller's waggon passing the house. b. p. c. the so. ended 1 or 2 secs. after the beg. of the sh.

2309. *Little Harrowden*.—Mr. Wooding* (c. by Mr. C. Crump). 3. 5.30. 4. two parts, the first a shaking of the window, as if by a sudden gust of wind, 2 or 3 secs.; after 3 secs., a movement of the bed acc. by a second rattling of the windows; the second sh. the stronger. g. S.W. to N.E. 6. 5. 7. no, but other observers heard a so. like a rapidly-driven cart on a stone road.

2310. *Long Buckley*.—(*Northampton Herald*, Dec. 19.) 3. bet. 5.30 and 6. 4. sh. felt.

2311. *Moulton*.—(Do.) 6. < 4.

2312. *Northampton*.—Miss E. W. Blackwell.† 3. ab. 5.35. 4. the bed was rocked steadily backwards and forwards from N. to S. 6. 5. 7. another obs. heard a so. as if boxes were being dragged about the floor.

2313. Do.—Mr. B. Thompson, F.G.S. 4. a trem. mot. 5. 3 or 4 secs. 7. no.

2314. Do.—(*Northampton Herald*, Dec. 19.) 3. ab. 5.35. 6. 5. 7. a mysterious rumbling noise.

2315. Do.—(*Kettering Leader*, Dec. 18.) 3. 5.35. 6. 5? 7. a rumbling noise.

2316. *Oundle*.—(*Standard*, Dec. 18.) 4. like the oscillations made by a traction-engine. 5. ab. 25 secs. 6. 4.

2317. *Peterborough*.—Mr. J. L. Barnett (c. by Mr. J. W. Bodger). 3. 5.37. 4. a trem. mot., which seemed to increase for ab. 5 secs. and then die away. g. N. to S. 6. pr. 5. 7. a rumbling so., coinciding with the sh.

2318. Do.—Mrs. Thompson* (Do.). 3. bet. 5.40 and 5.45. 6. 5. 7. a traction-engine passing. b. pr. c. c. c.
2319. Do.—M. A. Hammond† (Do.). 3. ab. 5.40. 5. several sec. 6. pr. 5. 7. a rumbling so. heard.
2320. Do.—K. E. Pearson (Do.). 3. ab. 5.30. 4. 2 prin. vibra, causing a jarring sensation. 6. < 5. 7. no.
2321. Do.—(*Peterborough Advertiser*, Dec. 19.) 3. directly after 5.30. 4. a slight sh., f. almost imm. by one more severe. 5. a few sec. 6. 5. 7. a traction-engine passing.
2322. *Pytchley*.—Mr. A. Warner.* 3. ab. 5.30. 4. a. yes. b. 2 vibra. c. yes. d. grad. incr. e. mid. f. yes. 6. 5. 7. distant artillery. b. c. c. c. d. yes. e. c. f. appeared to become sharper.
2323. *Rothwell*.—(*Kettering Leader*, Dec. 18.) 6. < 4.
2324. *Spratton*.—Mr. C. A. Markham, F.R.Met.S. (*Northampton Herald*, Dec. 19.) 3. 5.34. 4. a slight though distinct sh. 6. < 4.
2325. Do.—Mr. Pheasant (Do.). 3. ab. 5.45. 4. 2 distinct sha. 6. 5.
2326. *Stowe Hill* (near Weedon).—Mrs. Byrne. 3. 5.35. 4. 4 slow and distinct rocking movements, with a pause of ab. 3 sec. before the return movement; they were equal in int. 5. ab. 10 sec. 6. 5. 7. ab. 3 sec. after the sh., there was a so. like the fall of a heavy weight in the road (there was nothing outside to account for the noise).
2327. *Thrapston*.—(*Northampton Herald*, Dec. 19.) 3. ab. 5.30. 4. 2 sha., the second 5 mins. [sic] after the first. 6. 5. 7. a heavy rumbling so.
2328. Do.—(*Kettering Leader*, Dec. 18.) 6. pr. 5; in many cases, crockery was thrown down from the shelves.
2329. *Tiffeld*.—Mr. T. S. Stops. 3. 5.36. 4. the bed was lifted, as if in a small rowing boat in a swell on the sea. g. S. to N. 6. 5.
2330. *Towcester*.—(*Northampton Herald*, Dec. 19.) 3. bet. 5.30 and 5.40. 4. beds shaken.
2331. *Walgrave*.—(*Kettering Leader*, Dec. 18.) 3. ab. 5.30. 4. sh. felt.
2332. *Warkworth*.—(*Banbury Guardian*, Dec. 24.) 6. < 5.
2333. *Welford*.—Mr. G. Thurston.* 3. 5.38. 5. 5 to 10 sec. 6. 4. 7. a distinct rumbling.
2334. *Wellingborough*.—Mr. W. W. James† 3. 5.32. 4. a continuous shaking, pr. the second of 2 sha. g. N.E. to S.W. 5. < 15 sec. 6. 5.
2335. *Yardley Hastings*.—(*Northampton Herald*, Dec. 19.) 3. ab. 5.35. 5. 2 to 4 sec. 6. 5.

LEICESTERSHIRE

2336. *Ashby-de-la-Zouch*.—(*Leicester Chronicle*, Dec. 19.) 3. 5.45 A.M. 6. < 4.
2337. *Barrow-on-Soar*.—(Do.) 3. ab. 5.30. 6. 5.
2338. *Belvoir*.—(*Grantham Journal*, Dec. 19.) 3. ab. 5.40. 6. < 4. 7. a sudden rush of wind.
2339. *Belvoir Castle Gardens*.—Mr. W. H. Divers. 3. 5.34. 4. a. no.

b. 2 vibra. of the same int., ab. $\frac{1}{2}$ sec. bet. them. c. no. f. no. g. N.W. to S.E. 5. ab. $1\frac{1}{2}$ secs. 6. 5. 7. no.

2340. *Birstall*.—(*Leicester Chronicle*, Dec. 19.) 3. ab. 5.35. 4. 2 sha. 6. 5.

2341. *Bottesford*.—(*Grantham Journal*, Dec. 19.) 3. nearly 5.30. 4. only one sh., a quivering of the house as if caused by a heavy blow at the foundations. 7. no.

2342. *Broughton Astley*.—Mr. G. Sharman.* 3. 5.33. 4. suddenly the bed rocked from side to side. 5. ab. 5 secs. 6. 5. 7. there appeared to be a slight so. accompanying the sh.

2343. *Do.*—(*Leicester Chronicle*, Dec. 19.) 3. 5.35. 4. a distinct oscillatory movement. 5. 3 to 4 secs. 7. a low rumbling noise, like the distant so. of an approaching train, acc. the sh.

2344. *Buckminster*.—Rev. Astley Cooper (*Standard*, Dec. 21). 6. pr. 5. 7. a strange rushing so.

2345. *Carlton*.—(c. by Mr. G. F. Reader.) 3. between 5.30 and 6. 4. horizontal movements. g. S.W. and N.E. 5. ab. $\frac{1}{2}$ min.

2346. *Castle Donington*.—Rev. J. C. Roney-Dougal† 3. ab. 6.25 [sic]. 4. f. yes. 5. ab. 2 secs. 6. 5. 7. heavy waggons moving. b. p. imm.

2347. *Do.*—(*Leicester Chronicle*, Dec. 19.) 4. an oscillation. 6. \leftarrow 4. 7. a rumbling.

2348. *Dunton Bassett*.—Rev. A. Chiswell† 3. 5.35. 4. a. yes, 2 secs. b. yes, 10 secs. c. yes, ab. 3 secs. e. mid. f. yes. g. N.W. to S.E. 6. 5. 7. a heavy train passing swiftly under the house. c. f. d. yes. e. c. f. no.

2349. *Earls Shilton*.—Miss E. A. Carr. 3. about 5.40. 4. a. yes, scarcely perceptible. b. 4 or 5 vibra., the bed appeared to swing very gently. g. N. to S. 5. ab. 5 or 6 secs. 6. 5. 7. no.

2350. *Elmsleigh*.—Mr. J. Stafford, J.P.* 3. 5.9. 4. a rocking and quivering of the bed. 5. 1 or 2 secs. 6. 5.

2351. *Frisby-on-the-Wreake*.—(*Grantham Journal*, Dec. 19.) 3. ab. 5.30. 6. 5.

2352. *Gopsall Gardens* (near Atherstone).—Mr. J. Lee. 3. ab. 5.34. 4. 3 sha., close to one another. 5. 15 to 20 secs. 6. 5. 7. a noise resembling in int. a large quantity of coal falling or an underground explosion, coming from the S.W.; this apparently lasted only 1 or 2 secs., and was closely f. by an upheaval.—“In one of our conservatories we have a brick water-tank, which on the evening of the 16th was full to overflowing, and at 7.30 on the 17th there was but a very little water in the bottom. This had never happened before, and since then [written Dec. 28] we have found the tank to lose water at the rate of about 6 or 8 inches per day. This appears to point to a displacement of the masonry.”

2353. *Great Dalby*.—(*Grantham Journal*, Dec. 19.) 6. 5? 7. a slight rumbling noise as of distant thunder.

2354. *Hathern*.—(*Leicester Chronicle*, Dec. 19.) 3. ab. 5.30. 6. \leftarrow 4. 7. a strange rumbling noise.

2355. *Higham Hall*.—Anon.† (*Daily Telegraph*, Dec. 18). 3. 5.30. 6. 5? 7. the sh. was acc. by a muffled rumbling noise.

2356. *High Cross*.—Mr. E. J. Barwell. 3. 5.34. 4. 2 sha., the first lasting 15 secs., the second, after 3 or 4 secs., less severe. 6. \leftarrow 4. 7. no.

2357. *Hinckley*.—(*Leicester Chronicle*, Dec. 19.) 3. ab. 5.30. 4. a swaying motion. 6. \leftarrow 5; crockery was thrown down in places, and doors wh. were not fastened were thrown back. 7. a heavy vehicle passing.

2358. *Humberstone Road Junction*.—Mr. G. Green, J.P.* 3. 5.34.* 4. 3 distinct movements. g. E. to W. 6. \leftarrow 5; a large stone at the back of the fireplace moved quite 2 ins. out of the perpendicular at the first sh. and in a lesser degree at the two others.

2359. *Husbands Bosworth*.—Mrs. G. W. Phipps.† 3. 6.32 [*sic*]. 5. ab. $\frac{1}{2}$ min. 6. pr. 5. 7. thunder.

2360. *Isley Walton*.—Anon.† 3. 5.30. 4. as if some one had hold of the bed and pulled it backwards and forwards strongly. 6. 5; the wardrobe doors were thrown open. 7. no.

2361. Do.—(*Leicester Chronicle*, Dec. 19.) 6. pr. 5; a water-jug and glass were seen to sway on a table.

2362. *Kegworth*.—Lt.-Col. A. W. Mansergh. 3. 5.35. 4. one sh. only. f. yea. g. E. to W. 5. ab. 4 secs. 6. 5. 7. the so. not a rumbling, but more of a clatter (in other parts of the village, it was like a heavy traction-engine moving very rapidly and stopping suddenly). b. p. ab. 2 secs. c. c.

2363. *Kibworth*.—(*Kettering Leader*, Dec. 18.) 3. shortly before 6. 4. 2 distinct shs.

2364. *Leicester*.—Mr. J. W. Muston.* 3. 5.34. 4. a rattling of window-frames, f. by a distinct rocking of the house. g. N.W. and S.E. 5. 8 or 10 secs. 6. 5; a door on the third or top story of the house was swung open, not violently but steadily; it was nearly closed the previous evening.

2365. Do.—Mr. E. S. Bream.* 3. 5.35. 4. two distinct shs., 3 or 4 secs. interval bet. them; a heaving and rolling sensation. 6. 5. 7. both shs. were acc. by a rumbling so. like the beating of muffled drums or thunder; the so. was apparently only noticeable at the time of the shs. and c. with them in duration.

2366. Do.—Mr. C. V. Hartley.† 3. 5.34 or 5.35. 4. 2 series. 5. 5 or 6 secs. 7. awakened by a so. like that of a traction-engine passing and by slight tremor; then came the rumbling after a short interval; the so. continued after the rumbling, grad. dying away.

2367. Do.—Mr. W. Roddia. 3. 5.30 to 5.32. 4. the house swayed backwards and forwards. g. E. and W. 5. ab. 5 secs. 6. 5. 7. no.

2368. Do.—Mr. G. F. Sturges.† 3. 5.35. 6. \leftarrow 4.

2369. Do.—(*Leicester Chronicle*, Dec. 19.) 3. ab. 5.35. 4. the first movement lasted 3 or 4 secs., and was imm. f. by another sh. of equal duration and int., while, in some instances, a third, but only very slight, tremor is said to have been noticed. 6. 5.

2370. Do.—Mr. F. F. Palmer (Do.). 3. 6.35 [*sic*]. 4. the bed seemed to be rocked quietly. 5. several secs. 6. 5.

2371. Do.—Mr. H. Banton * (Do.). 3. ab. 5.40. 4. 2 shs. of equal severity, f. by a slight tremor. 6. 5.

2372. Do.—Mr. J. W. Urquhart (Do.). 3. 5.35. 4. 2 or more strongly marked shs., separated by an interval of ab. 3 secs. 6. 5. 7. the shs. were acc. by a loud rumbling noise, somewhat resembling distant thunder.

2373. Do.—(Do.) 5. 12 or 15 secs. 6. the ceilings of some rooms showed new cracks; in a few houses fragile ornaments were thrown down.

2374. *Little Peatling*.—Mrs. Bastow (c. by Rev. T. C. V. Bastow). 3. 5.32½. 4. only one series. 6. pr. 5. 7. a threshing-machine on the road 70 yds. away. b. p. d. yes. e. f.

2375. *Long Whatton*.—(*Loughborough Herald*, Dec. 24.) 3. 5.35. 6. < 5; bottles jarred one against another. 7. a rumbling noise.

2376. *Loughborough*.—Mr. G. Adcock.* 3. 5.35. 4. 2 prolonged series of vibrs, each commencing softly, increasing in the middle, and ending



FIG. 5.

softly, as in the accompanying diagram. 5. ab. 3 or 4 secs. each. 6. < 4. 7. no.

2377. *Do*.—Mr. J. Garton.* 3. 5.36. 4. d. yes. e. mid. 6. 4. 7. a traction-engine or steam-roller passing. d. yes.

2378. *Market Bonworth*.—Mr. H. W. Beck.† 3. 5.29. 4. d. yes. e. mid. f. no. g. N. to S. 5. at least a min. 6. 6. 7. a traction-engine passing. c. c. d. yes.

2379. *Market Harborough*.—Mr. J. B. Bragg.† 3. 5.35. 6. 5.

2380. *Do*.—(*Kettering Leader*, Dec. 18.) 3. bet. 5 and 6. 5. a few secs. 6. 4. 7. a faint rumbling so. acc. the sh.

2381. *Melton Mowbray*.—(*Grantham Journal*, Dec. 19.) 3. ab. 5.35. 4. in some cases, 2 sha. were felt. 6. pr. 5; in one house, one or two articles on a dressing-table were thrown down. 7. a low so. heard.

2382. *Mountsorrel*.—Rev. A. R. Watson. 3. 5.35. 4. the motion like that caused by a heavy traction-engine. 5. ab. 15 secs. 6. < 4. 7. a heavy traction-engine passing.

2383. *Oadby*.—Mr. H. P. Curtis.† 3. 5.40. 4. 2 sha., the first lasting ab. 5 secs., the interval ab. 3 secs., the second and more severe 5 secs., dying away in ab. 3 secs.; the movement as if some one had taken hold of the foot of the bed and shaken it violently. f. yes. 5. 15 or 16 secs. 6. 5. 7. a traction-engine passing.

2384. *Oaks Vicarage, The* (near Loughborough).—Rev. W. R. Taggart.† 3. 5.35. 5. a few secs.

2385. *Packington*.—(*Leicester Chronicle*, Dec. 19.) 6. jars and crockery were shaken from shelves.

2386. *Quorn*.—Mr. O. S. Brown (Do.). 6. < 4; a bottle was shaken from a table.

2387. *Shepshed*.—Rev. W. F. H. Hepworth.† 4. 2 sha., the first and stronger lasting ab. 15 secs., being marked by an uplifting of the bed; the second, after an interval of a min., lasting 10 secs., with more pronounced vibrs. 6. 5. 7. a very heavy traction-engine and train passing. b. c. or f. imm.

2388. *Six Hills* (near Leicester).—Miss C. M. Jones.† 3. 5 or 5.30. 6. < 4.

2389. *South Wigston*.—Mr. H. W. Clarke. 3. ab. 5.30. 4. one continuous vibr., like that made by a heavy traction-engine passing. 5. ab. 3 secs. 7. no.

2390. *Swithland*.—(*Leicester Chronicle*, Dec. 19.) 6. 5.

2391. *Syston*.—Mr. Wand† (Do.). 4. the bed appeared to be lifted and rocked from side to side. 6. 5.

2392. *Thurmaston*.—(Do.) 6. pr. 5.

2393. *Walcote*.—Captain Corbet Smith.* 3. 5.35. 4. only one sh. (a few people felt 2 shs.) 5. 4 or 5 secs. 6. 5. 7. the rumbling so. at the time of the sh. was like heavy waggons passing over stones; after the sh. there was a loud and very peculiar moaning so. something like that of a threshing-machine.

2394. *Waltham*.—(*Grantham Journal*, Dec. 19.) 3. 5.45. 4. a rocking sensation. 5. 5 or 6 secs. 6. 5? 7. the sh. was acc. by a rumbling noise.

2395. *Wanlip*.—Mr. C. Blankley. 3. 5.40. 6. 5? 7. a great rumbling noise p. the sh.

2396. *Whetstone*.—(*Leicester Chronicle*, Dec. 19.) 3. 5.34. 6. < 4. 7. the sh. acc. by a rumbling noise.

2397. *Withcote*.—Col. F. Palmer.* 3. ab. 5.30. 4. a hollow roaring so., like subterranean thunder, grad. increasing in volume, lasting 7 or 8 secs., without any perceptible shaking; f. after ab. 7 or 8 secs. by a rocking of the house from N.W. to S.E. 6. 5. 7. yes, see above.

2398. *Woodhouse Eaves*.—Mrs. Dashwood. 3. 5.34. 4. a shaking and lifting sensation, only one sh. 5. ab. 2 secs. 6. < 5; bottles standing in a long row on a slippery shelf were all moved in one direction (see Fig. 6),

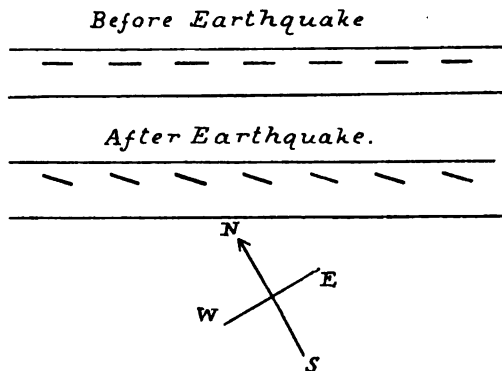


FIG. 6.

like soldiers drilling, so uniform was the movement. 7. the sh. was acc. by loud rumbling and explosive sounds. c. f. 2 or 3 secs. (In the village, doors flew open and a few rickety things were upset.)

RUTLAND

2399. *Barrowden*.—Rev. H. V. Bacon.* 3. 5.39 A.M. 4. a sustained rolling motion, increasing in int. as it grew nearer. g. E. to W. 6. 5. 7. a whizzing so.

2400. Do.—Anon.† (c. by Rev. H. V. Bacon). 4. 2 distinct shs, each lasting ab. 20 secs, with an interval of ab. 10 secs.

2401. *Braunston*.—Rev. B. Barrett.* 3. 5.37. 4. a distinct upheaval, wh. lifted the N.E. side of the bed first and then the S.W. side; one sh. only. 5. 5 to 10 secs. 6. 5. 7. yes: the so. ceased suddenly and entirely p. the sh.

2402. *Burley-on-the-Hill*.—G. H. Finch. 3. 5.35. 4. 2 shs, the first scarcely ceasing before the rocking recommenced, the second stronger. g. N. to S. 5. 30 secs. 6. 5. 7. a rumbling noise, like thunder and lasting ab. 10 secs, p. the first sh.; there was no noise during or after either sh.

2403. *Clipsam*.—Mrs. E. A. Davenport-Hamley.† 3. 5.45. 4. an upheaval of the bed. 5. + 1 sec. 6. 5.

2404. *Exton*.—(c. by Rev. R. C. Scrimgeour.) 4. sh. felt.

2405. *Lyndon*.—Miss A. Conant.† 3. 5.35. 4. the bed rocked gently (other people in the neighbourhood felt 2 shs). 6. 5. 7. a train passing underground.

2406. *Market Overton*.—Mr. E. Costall. 3. 5.37. 4. only one sh. f. yes. 5. ab. 6 or 7 secs. 6. 5. 7. no.

2407. *Oakham*.—L. Fitch. 3. bet. 5.30 and 5.45. 4. apparently horizontal vibrs, p. and f. by trem. mot. 5. ab. 2 secs. 6. 5.

2408. Do.—(*Grantham Journal*, Dec. 19.) 6. pr. 5; in one house, the tiles of the sides of a fireplace were dislodged and fell on the hearth.

2409. *Stretton*.—Anon.* (c. by Mrs. Davenport-Hamley). 7. a heavy waggon passing, without the noise of the horses.

2410. *Teigh*.—Mrs. Newby. 3. 5.40. 6. 5? 7. after the sh., there was a report in the distance like the blasting of a rock. (To another obs., the so. appeared like the rushing of a train from W. to E.)

LINCOLNSHIRE

2411. *Alford*.—Mr. L. Wilson.* 3. 5.40 A.M. 4. as if a traction-engine were passing the house. 6. "Looking afterwards at the pictures in my room, I find those hanging on the N. and S. walls are displaced, while those on the E. and W. walls appear unmoved."

2412. *Billingham*.—Mr. T. E. Branson (*Grantham Journal*, Dec. 19). 3. ab. 5.30. 5. several secs. 6. 5? 7. a lumbering noise acc. the vibr.

2413. Do.—Anon.† (Do.). 5. ab. 3 or 4 secs. 6. 4. 7. a terrific gust of wind.

2414. *Bourne*.—Miss L. M. Andrewa.† 4. bed strongly shaken, as if some one had taken hold of the foot. g. N. to S. 5. some secs. 6. pr. 5. 7. other observers heard a rumbling noise.

2415. *Fulbeck*.—(*Grantham Journal*, Dec. 19.) 4. the vibr. like that caused by a heavy engine passing.

2416. *Gainsborough*.—Mr. F. M. Burton, F.G.S.† 3. 5.36. 4. awakened by a creaking noise, f. by a quick vibr. for ab. 2 secs.; after an interval of ab. 1 sec., another vibr., much louder than the first, and lasting ab. 2 secs.;

and after another interval of ab. a sec., a third vibr. nearly as loud as the second and also lasting ab. 2 secs. 6. pr. 4. (The sh. was felt more severely on the low-lying ground in the Trent valley.)

2417. *Grantham*.—(*Grantham Journal*, Dec. 19.) 3. ab. 5.30. 4. 2 distinct upheavals. 5. a very few secs. 6. 5. 7. no.

2418. *Hough-on-the-Hill*.—(c. by Mr. E. Lloyd-Davies.) 3. bet. 5.30 and 5.33. 4. 2 distinct shakings of equal int., separated by a very small fraction of a min. 5. 2 to 3 secs. 6. < 4; in one house, a quantity of water was spilt out of a jug. 7. a heavily-laden waggon going over stones or a traction-engine passing; the so. p. the sh. and appears to have ended before it began.

2419. *Leadenham*.—The Hon. Mrs. Reeve.† 3. ab. 5.30. 4. one series of vibrs. f. no. 7. a wheel-barrow trundled on a hard and frosty road. b. c. d. the so. ended abruptly.

2420. *Leasingham*.—Mr. H. Jessopp.† 3. 5.43. 4. the vibr. similar to that caused by a traction-engine passing the house, but much more pronounced; it lasted a few secs, stopped, and went on again for a few secs. 6. pr. 4; a night-light in a glass on top of a water-bottle was upset. 7. no.

2421. *Lincoln*.—Mr. J. Smalley † (*Grantham Journal*, Dec. 19.) 3. bet. 5 and 6. 6. pr. 5. 7. the sh. was acc. by an ominous rumbling noise.

2422. *Do*.—Mr. G. Lewis (Do.). 7. the falling of a heavy load of snow from a house-top.

2423. *Do*.—Anon.† (Do.). 4. the bed rose, as if lifted by some one beneath it. 6. a wardrobe knocked against the wall.

2424. *Long Bennington*.—(Do.) 3. ab. 5.30. 4. as if a heavy traction-engine were passing.

2425. *Midville*.—Mr. W. S. Carter.* 3. 5.35. 4. like a boat riding over a very large wave and coming down quickly. g. E. to W. 5. 4 or 5 secs. 6. < 4.

2426. *Morton*.—Rev. W. Stockdale.† 6. < 5. 7. a rumbling noise c. with the sh.

2427. *Sausthorpe*.—Major C. A. Swan.† 3. before 6. 5. < 2 secs. 6. 4. 7. a fall of a heavy piece of furniture.

2428. *Searby*.—Mr. T. B. Coates.* 3. 5.35. 4. the bed was shaken 5 or 6 times. 5. 4 or 5 secs. 6. pr. 4. 7. a gust of wind (quite calm at the time). b. f. imm.

2429. *Sleaford*.—Anon. 6. 4 or 5.

2430. *Stamford*.—Anon. 3. 5.34. 4. the bed was tilted up and then the whole floor seemed to roll as a vessel at sea. 6. 5. 7. a curious rushing noise.

2431. *Do*.—Mr. H. Betta.† 3. 5.40. 6. 5.

2432. *Do*.—(*Lincoln, Rutland and Stamford Mercury*, Stamford, Dec. 18.) 3. 5.40. 6. pr. 5; a fancy candlestick was shaken down and broken; water was jerked out of a jug into the basin.

2433. *Thurlby*.—(c. by Mr. H. E. Smith.) 3. ab. 6. 4. a slight shaking. 6. 4. 7. very heavy timber-drags going along the road.

2434. *Washingtonborough*.—(*Lincolnshire Chronicle*, Lincoln, Dec. 19.) 3. ab. 5.30. 4. sh. distinctly felt. 6. a quantity of soot fell down one chimney.

2435. *Welbourn*.—Anon.* (Do). 3. ab. 5.30. 5. several secs. 6. 4 or 5. 7. a dull rumbling so.

2436. *Wellington*.—Mr. H. E. Cooke.* 3. ab. 5.30. 4. as though some one were heaving it up and rocking it, each oscillation lasting perhaps a sec. d. yes. e. mid. 5. ab. 10 secs. 6. 5. 7. no.

2437. *Whisby*.—Mr. Moss† (*Lincolnshire Chronicle*, Lincoln, Dec. 19). 3. ab. 5.30. 6. < 5.

2438. *Wigsley*.—(Do.) 3. ab. 5.35. 5. a few secs. 6. 5?

2439. *Woolthorpe-by-Belvoir*.—(*Grantham Journal*, Dec. 19.) 3. 5.30. 6. 5.

2440. *Wytham-on-the-Hill*.—Mr. A. C. Johnson† 3. ab. 5.30. 4. the bed upheaved as though some one were underneath it. 5. 2 or 3 secs. 6. 5. 7. no.

2441. Do.—(c. by Mr. H. E. Smith.) 4. a slight vibr. 6. 4.

NOTTINGHAMSHIRE

2442. *Bleasby*.—Rev. H. L. Williams.* 3. 5.30 or 5.31. 4. the sh. consisted of two distinct parts, the first and more violent lasting ab. 10 secs. (or perhaps less); the second a kind of echo, lasting ab. the same time, and softening until it ceased altogether. 6. 5. 7. no.

2443. *Blidworth*.—Rev. R. H. Whitworth.* 3. ab. 5.35. 5. a very few secs. 7. a bang, more than a rumble.

2444. *Bramcote*.—Mr. E. M. Smith† 3. 5.35. 4. one sh. only; a quick and even motion from side to side. g. N.W. and S.E. 6. 5. 7. no; but others in the house heard a so. like the wind rising or a train coming near.

2445. *Cauntton*.—D. H. Brooksbank† 3. 5.37. 4. the movement like that felt in a train when going over a suspension-bridge. 6. 5. 7. a train going over a suspension-bridge, but not nearly so loud.

2446. *Cropwell Butler*.—Mr. J. S. Cole.* 3. 5.35. 5. 10 or 15 secs. 6. 5. 7. no.

2447. *Gotham*.—Rev. F. A. Wodehouse.* 3. bet. 5.36½ and 5.39. 4. as if a dog had suddenly jumped upon the bed and begun to scratch itself rather violently. 5. 6 to 15 secs. 6. 5.

2448. *Lenton*.—M. E. Gadd.* 3. ab. 5.30. 4. the bed swayed and, after a short interval, everything in the room trembled. 6. 5. 7. a peculiar rumbling with the second part of the sh.

2449. *Lynby*.—Rev. W. C. Weddall* 3. 5.32. 4. a sudden, violent, and continuous shaking. 5. 5 or 8 secs. 6. pr. 5. 7. no.

2450. *Newark*.—(*Standard*, Dec. 18.) 3. ab. 5.30. 4. 2 distinct shs. 6. 4.

2451. *Newstead Abbey*.—Lady Helena Carnegie. 3. 5.32 or 5.33. 4. the bed rocked from side to side, the motion resembling the rolling of a ship at sea; only one sh. g. E.S.E. to W.N.W. 5. ab. 10 secs. 6. 5. 7. the low roar of wind in a chimney, not loud. b. p. 1 or 2 secs. c. p.

2452. *North Collingham*.—(c. by Rev. F. W. Goodacre.) 3. ab. 5.35 or

5.40. 4. b. one vibr. c. yes, 2 or 3 secs. d. yes. f. no. g. N.E. to S.W. 5. 3 secs. 6. 5. 7. yes. b. p.

2453. *Nottingham*.—Mr. L. Gibson.* 3. 5.34. 4. $\frac{2}{3}$ shs., separated by an interval of 2 or 3 secs., the second part much the stronger. f. yes. 5. ab. 15 or 16 secs. 6. 5. 7. a lumbering so., like that of a waggon passing over a road paved with stone pebbles; becoming louder until the sh. was felt.

2454. Do.—Nurse E. C. Pierce.* 3. bet. 5.35 and 5.40. 6. < 4.

2455. Do.—Mr. H. Hartley.* 3. ab. 5.30. 4. a violent shaking for 3 secs.; then, after an interval of 5 secs., a second and much more severe sh. occurred, lasting 2 secs., the bed shaking considerably. 6. 5. 7. a heavy cart passing in the distance from the S.E.; it was heard in the interval bet. the 2 shs.

2456. Do.—Mr. H. W. Salmon* (c. by Mr. H. Wilkins). 3. bet. 5.25 and 5.30. 4. d. yes. e. mid. f. slightly. 5. ab. 15 secs. 6. 5. 7. a rushing so. d. yes.

2457. Do.—Mr. A. B. Gibson.† 3. ab. 5.40. 6. 4. 7. awakened by a noise like a sudden rush of wind, f. without any interval by a rumbling noise like thunder, wh. appeared just beneath the house and shook the crockery, etc., very much.

2458. Do.—Mr. G. E. Harrison † (c. by Mr. H. Wilkins). 3. ab. 5.30. 4. 2 shs., at an interval of ab. 5 secs., the second more intense. 5. the second sh. ab. 8 or 9 secs. 6. < 4.

2459. Do.—Mr. S. Watson.* 3. 5.32. 6. 4. 7. a heavy traction-engine passing, coming from the W.

2460. Do.—Mr. A. Gilbert.† 3. 5.40. 4. the bed lifted up and down for 5 or 6 secs., and, imm. afterwards, it shook from end to end for 10 or 12 secs. 6. 5. 7. carts discharging coal.

2461. Do.—Anon.* (c. by Mr. J. Vice). 3. pr. a few mins. after 5.30. 6. < 4.

2462. Do.—J. Herbert † (c. by Mr. H. Wilkins). 3. 6.45 [*sic*]. 6. < 4. 7. a carriage passing the house. b. c. d. no.

2463. Do.—G. Sharp (Do.). 3. 5.45. 4. 2 prin. vibra. [series?], lasting 2 or 3 secs. each. 7. yes. e. c.

2464. Do.—Mr. W. A. Mann (Do.). 3. ab. 5.35. 4. the bed rocked backwards and forwards ab. 4 times. 5. ab. 5 or 6 secs. 6. 5. 7. a kind of humming, like the vibr. of an engine-boiler; then the house rocked.

2465. Do.—Mr. F. C. Porter.† 4. the vibra. of the same int. throughout. f. no. 6. 5. 7. a heavy cart or steam-roller passing.

2466. Do.—Mrs. J. Bolton (c. by Mr. H. Wilkins). 6. pr. 5; the ceiling in every room was cracked. 7. a waggon passing. b. p.

2467. Do.—(c. by Mr. J. Shipman.) 4. a rocking of the bed, f. imm. by 3 sharp vibra. of the window-sashes. g. W.S.W. to E.N.E. 6. 5. 7. a loud noise as of an explosion.

2468. Do.—Mr. G. J. Bowles. 3. ab. 5.30. 4. only one sh. 5. > 1 or 2 secs. 6. 5.

2469. Do.—(*Daily Telegraph*, Dec. 18.) 3. ab. 5.30. 4. 2 shs. 5. 5 to 10 secs. 6. < 4. 7. the sh. was imm. p. by a rushing so.

2470. Do.—(*Gloucestershire Echo*, Cheltenham, Dec. 17.) 3. ab. 5.30.

4. 2 shs., the first lasting ab. 5 secs.; the other, of shorter duration, following after an interval of a min. 6. pr. 5; in some houses crockery was broken.

2471. Do.—Mr. C. Lennard (*Nottingham Evening News*, Dec. 17). 6. a glass on a table was overturned. 7. a rumbling noise.

2472. *Radcliffe-on-Trent*.—Mr. R. Butler.† 3. 5.33. 4. one sh., wh. grad. died away. 5. 15 secs. 6. 5. 7. a distant rumbling noise, like the firing of a cannon, lasting 2 or 3 secs. b. p. c. p.

2473. Do.—Mr. A. M. Whitehead.* 3. ab. 5.30. 6. 4 or 5. 7. a distant rushing wind; directly afterwards the bed trembled.

2474. *Radford*.—Mr. W. Richardson. 4. only one sh.; a swaying motion from N. to S. 5. > 10 secs. 6. pr. 5. 7. a cart passing: the swaying motion f. the noise imm.

2475. *Retford*.—Mr. L. D. Roworth. 3. 5.35. 4. the bed rose slowly and moved with a waving motion to and fro. 6. 5.

2476. Do.—(*Sheffield Daily Telegraph*, Dec. 18.) 3. ab. 5.20. 4. a distinct sh. 5. ab. 2 secs.

2477. *Sutton Bonnington*.—(*Loughborough Herald*, Dec. 24.) 3. ab. 5.35. 6. 5. 7. yes. b. p.

2478. *Winkburn*.—Anon.* 3. 5.30. 4. a swinging motion of the bed. 5. > $\frac{1}{2}$ min. 6. 5. 7. a heavy rumbling so. heard by another obs.

2479. *Wiverton Hall*.—Mrs. Musters. 3. bet. 5.40 and 5.45. 4. 2 shs. 6. < 4. 7. no.

2480. *Workop*.—Rev. H. T. Slodden.* 3. 5.35. 4. a rocking sensation like that felt in a small boat riding over the crest of a wave. g. W. to E. 5. > 5 secs.* 6. 5. 7. no.

2481. Do.—Anon. (c. by Mr. C. Tylden Wright). 4. 2 separate shs., as if a heavy dog had jumped on the bed, and then down again, shaking the room.

DERBYSHIRE

2482. *Ashbourne*.—Anon.* (c. by Rev. F. Jourdain). 3. 5.45. 4. the house appeared to swing from side to side with a regular and even movement, exactly like a ship rolling. 5. 15 secs. 6. 5; one piece of furniture slightly struck the wall 12 times. 7. a loud roll, like thunder, c. with the movement and died away directly afterwards. (Mr. Jourdain adds: "A high wall at the back of our Grammar School has fallen, partly, I believe, through the sh., and loosening of the foundation.")

2483. *Ashford*.—Mr. R. Clifford Smith.† 3. ab. 5.32. 4. the bed was gently rocked. 6. pr. 5.

2484. *Ashover*.—Mr. W. Mitchell.* 3. ab. 5.35. 4. f. yes. 5. a few secs. 6. 5. 7. no.

2485. *Bakewell*.—Anon.† 3. 5.33. 4. d. yes. f. no. 5. ab. 5 to 7 secs. 6. < 4.

2486. Do.—(*Sheffield Daily Telegraph*, Dec. 18.) 3. ab. 5.25. 6. "pictures were displaced."

2487. *Belper*.—(c. by Mr. F. A. Friend.) 3. ab. 5.30. 6. < 4.

2488. Do.—(*Sheffield Daily Telegraph*, Dec. 18.) 3. 5.40 to 5.50.
6. < 4.
2489. *Brookhill*.—Col. W. L. Coke, D.L., J.P.† 3. bet. 5.15 and 5.30.
6. the door of one room, wh. works rather stiffly, came open. 7. no.
2490. *Buxton*.—Mr. J. G. Farrer-Morgan.* 3. bet. 5.33 and 5.34. 4.
5 or 6 vibrs., as though some one were shaking the bed strongly and at the
same time slightly raising it. 5. 5 or 6 secs. 6. 5. 7. no.
2491. Do.—H. M. E. Higinbotham.* 3. 5.20. 4. 2 sha., the bed
appeared to sway. 6. 5. 7. imm. after the sha., there appeared to be a
mighty rush of wind.
2492. *Chapel-en-le-Frith*.—Mr. J. T. Gray.† 3. 5.30 to 5.35. 4.
awakened by a violent shaking of the windows; in a few secs. the bed
heaved up. 5. ab. 10 secs. 6. 5. 7. a loud rumbling noise.
2493. *Codnor*.—Mr. S. Alsop.* 3. ab. 5.30. 4. a shaking of the bed,
N. and S., for 4 or 5 secs., then a rest of as many secs., and a second shaking
similar to the first in extent and duration; again a pause and a third
shaking of a mild character. 7. a so. as of a rush of wind before the first
shaking.
2494. *Darley Dale*.—Mr. J. J. Brigg.* 4. the bed moved up and down
2 or 3 times. 6. 5?
2495. *Derby*.—Mr. G. H. Powell.* 3. ab. 5.32. 4. the chair was
rocked to and fro 3 or 4 times. 6. 5: some plates resting in a slanting
position against a bar fell down. 7. a steam-roller in the distance. b. p.
2496. Do.—A. L. Henley.* 3. ab. 5.40. 6. 5. 7. a so. as of a fire-
engine coming up at a rapid pace and dying away again, ending before the
sh. began.
2497. Do.—Mr. C. H. Taylor.* 3. 5.39. 4. the bed rocked trans-
versely 4 or 5 times each way, and, in the dim light, it appeared to move
through some inches; the movement ceased with a peculiar shuddering or
settling-down action. g. S.W. and N.E. 5. 4 or 5 secs. 6. 5. 7. like
the so. made when a spinning plate finally settles to rest; this so. heard with
the "shuddering" only.
2498. Do.—Mr. J. White.† 3. 5.33. 4. 2 distinct sha., the second
stronger; the duration of each sh. ab. 3 to 5 secs., of the interval 10 to 15
secs. g. N.E. to S.W. 6. 5. 7. yes.
2499. Do.—Mrs. Arnold Bemrose* (c. by Mr. H. Arnold Bemrose, F.G.S.).
3. 5.32 or 5.33. 4. one series only; the head of the bed (to E.S.E.) was first
lowered and then the foot. 5. pr. 2 or 3 secs. 6. 5. 7. like a dull thud
against the side of the house, f. by a noise something like that of an escape
of gas, but of a lower pitch.
2500. Do.—Miss Holme (Do.). 3. ab. 5.35. 4. only one series, a rapid
up-and-down motion. 5. ab. 5 secs. 6. 5. 7. a so. like a rocket whizzing
through the air and acc. by a distinctly musical note like wind through a
keyhole, only louder and higher; the so. lasted only 1 or 2 secs.; the sh. was
over, or nearly so, before the so. was heard.
2501. Do.—Mr. W. W. Miller (Do.). 3. 5.30. 4. a short, undulating,
pitching motion. 5. 9 or 10 secs. 6. 5. 7. a rolling so. heard only after
the sh. c. f. 3 or 4 secs.
2502. Do.—Mr. H. Woogan † (Do.). 3. ab. 5.30. 4. a violent lateral

motion. g. N. and S. 5. ab. 4 secs. 6. 5. 7. the rumbling of a heavy vehicle in the distance, grad. subsiding; c. with the sh.

2503. Do.—Mr. A. S. Horrex.* 3. bet. 5.34 and 5.35. 4. the bed rocked from N. to S.: "before 3 secs. had elapsed from the beg. of the sh., I placed my hand upon the wall of the bedroom and found it to be vibrating twice as rapidly as my bed swung." 5. 5 secs. 6. 5. 7. no.

2504. Do.—Mr. F. F. Gray. 3. ab. 5.37. 5. ab. 4 secs. 6. 4. 7. yes (by others).

2505. Do.—Mr. T. W. Roberts† (*Derby and Chesterfield Reporter*, Dec. 18). 3. ab. 5.15 to 5.30. 4. like the pitching of a vessel. 6. pr. 5. 7. the sh. acc. by a weird rumbling noise.

2506. Do.—Mr T. Hall (Do.). 3. ab. 5.30. 6. 5.

2507. Do.—"F. W." (Do.). 3. 5.33. 4. 8 or 10 oscillations of a pleasant, rocking character. g. E. and W. 5. pr. 8 to 10 secs. 6. 5. 7. the sh. acc. by a rumbling noise.

2508. Do.—Anon.† 3. ab. 5.20 to 5.30. 4. a violent shaking of a peculiar swinging character. 5. 1 or 2 secs. 6. pr. 5; the curtains shook to and fro as if blown by wind.

2509. *Glossop*.—(c. by Rev. A. P. Hamilton-Wilson.) 6. pr. 5.

2510. Do.—(*Sheffield Daily Telegraph*, Dec. 18.) 3. ab. 5.40. 4. an oscillating movement.

2511. *Hartington*.—Rev. W. Fyldea. 3. bet. 5 and 6. 4. 3 or 4 vibrs. e. beg. f. no. 5. 4 or 5 secs. 6. 4. 7. no.

2512. *Kirk Ireton*.—Mr. B. Abell. 3. ab. 5.30. 4. a continuous shaking. 5. ab. 5 or 6 secs. 6. pr. 5; a tray, leaning against a prop, was shaken down. 7. a waggon rumbling along.

2513. *Lea Hurst*.—Mrs. Nightingale. 3. ab. 5.30. 4. long, gentle swaying movements, like a ground-swell at sea. 5. ab. 3 secs. 6. 5. 7. a very loud noise, wh. ceased as the sh. began.

2514. *Long Eaton*.—Mr. M. Plackett.* 3. 5.34 or 5.35. 5. ab. 5 or 6 secs. 6. < 4. 7. the sh. was f. by a low rumbling so., not unlike distant heavy thunder, wh. lasted ab. 5 or 6 secs. more.

2515. *Matlock Bath*.—Mr. R. W. Hackwood.* 3. 5.34 to 5.35. 4. the sh. in 2 distinct parts; the first part, by far the stronger, consisted of 2 distinct upheavings, in wh. the bed appeared to rise from 4 to 6 inches, there being 1 or 2 secs. bet. them, lasting altogether 3 to 5 secs.; interval, 5 secs.; the second part, also lasting 3 to 5 secs., a shaking of the walls; quite a different motion. 6. 5. 7. no.

2516. *Mickleover*.—Mr. R. W. Stevenson.† 3. 5.35. 4. a dull thud, f. by a violent shaking of everything in the room. 5. 9 or 10 secs. 6. < 4.

2517. *New Mills*.—Mr. S. Rendall. 3. ab. 5.40. 6. 5. 7. a rumbling noise heard by others.

2518. *Normanton*.—Mr. G. Cash.* 3. 5.30. 4. one continuous vibr., without any change of int. 5. 25 secs. 6. 5. 7. a steam-roller or heavy cart. b. c. c. d. no change of int.

2519. Do.—Mr. A. Newland* (*Derby and Chesterfield Reporter*, Derby, Dec. 18). 3. ab. 5.30. 5. ab. 9 secs. 6. small pieces of plaster fell.

2520. *Quarndon*.—Mr. G. Hampshire.† 3. ab. 5.32. 4. a violent rocking, grad. dying away. 5. ab. 3 secs. 6. 5. 7. no.

2521. *Repton*.—Mr. A. Rice.† 3. 5.30. 4. the sh. consisted of 2 parts, separated by 1 or 2 secs. 5. 5 or 6 secs. 6. 5? 7. (according to another obs.) a traction-engine passing.

2522. *Ridgeway*.—E. Hutton. 3. 5.30. 4. the bed swayed from W. to E. and back several times. 6. 5. 7. no.

2523. *Spondon*.—Mr. H. Downes.† 3. 5.30 to 5.40. 4. b. 2 max, 8 to 10 secs. c. yes, 10 to 12 secs. f. no. 6. 4. 7. a heavy vehicle passing. c. p. ab. 10 secs. d. yes. e. pr. c. f. no.

2524. *Tupton*.—Mr. A. G. Barnes, J.P.† 3. 5.35. 4. 6 prin. vibrs., forming a continuous swinging motion, of the same int. 5. several secs. 6. 5. 7. (according to another obs.) distant thunder; the vibrs. began imm. the so. ceased. d. yes.

2525. *Walton Hall*.—Anon.* 3. ab. 5.30. 4. the bed oscillated from side to side. 6. 5. 7. a heavy coal-cart being drawn up the hill.

2526. *Wirksworth*.—Rev. W. H. Arkwright. 3. ab. 5.35. 6. 5. 7. a heavy body falling.

YORKSHIRE

2527. *Ackworth*.—Major W. B. Arundel.† 4. the bed shook. 5. a few secs.

2528. *Adel*.—E. H. Ford.† 4. the vibrs. vert. and of the same int. 6. 5? 7. no.

2529. Do.—Mr. A. P. Baines.† 3. 5.35 A.M. 5. ab. 10 secs. 6. 5? 7. no; but others heard a so. like the rumbling of heavy carts.

2530. *Barnsley*.—Mr. H. Pigott.* 3. 5.30 to 5.35. 4. 8 or 10 vibrs. f. yes. g. N. to S. 5. 5 secs. 6. 5. 7. a dull heavy thud, like the discharge of heavy ordnance, before the vibrs., ab. 5 or 6 secs. bet. them.

2531. Do.—Anon.* (c. by Mr. H. B. Nash). 3. 5.30. 5. 2 or 3 secs. 6. 5. 7. a railway-train passing in a deep cutting.

2532. Do.—Mr. W. E. Brady.† 3. bet. 5.30 and 6. 4. 2 shs., the first stronger. 6. pr. 4. 7. no.

2533. Do.—Anon. (c. by Mr. E. G. Bayford). 3. bet. 5 and 6. 4. 2 vibrs., of equal int., in quick succession. 6. pr. 5. 7. no.

2534. *Batley*.—Mr. H. A. Hovey.* 3. 5.32½. 4. only one sh. 5. 15 to 20 secs. 6. 5? 7. the sh. was p. and f. imm. by a rushing wind, and acc. by a low rumbling noise like distant thunder.

2535. Do.—Mr. J. E. R. Polak (*Dewsbury District News*, Dec. 19). 3. 5.30. 4. a violent vibr. 5. 5 or 6 secs.

2536. *Bilton Junction*.—Mr. G. Duffield* (*Bradford Observer Budget*, Dec. 19). 3. 5.34.* 5. 1 min. 6. 4.

2537. *Bradford*.—Rev. W. Cunliffe.* 3. 5.24. 4. a. yes, ab. 2 secs. b. imm. after, the bed was slightly raised on the E. side and then lowered as the bed rose on its W. side, ab. 2 secs. 5. ab. 4 secs. 6. pr. 5.

2538. Do.—Mr. W. G. Tacey† (c. by Mr. C. B. Holdsworth). 3. ab. 5. 6. 4. 7. a rumbling noise, louder than usually heard from passing cars.

2539. Do.—Mr. R. A. Clarke.* 3. 5.35. 4. the bed seemed to rock very slightly from side to side, i.e. N. and S. d. yes. 5. 15 to 20 secs. 6. pr. 4.

2540. Do.—(*Standard*, Dec. 18.) 3. ab. 5.45. 6. 5?
2541. Do.—Mr. O. Sachs† (*Bradford Observer Budget*, Dec. 19.) 3. 5.45. 6. 4.
2542. *Brighouse*.—Mr. W. Aspinall* (*Halifax Courier*, Dec. 19.) 3. 5.30. 4. as if a large steam-roller were approaching. 6. pr. 4. 7. no.
2543. *Carperby*.—Mrs. Dent (c. by Mr. J. E. Clark). 3. ab. 5.30. 6. 4.
2544. *Castleford*.—Anon.* (*Yorkshire Post*, Leeds, Dec. 19.) 3. 5.36. 4. the bed rocked to and fro. 6. pr. 5. 7. imm. before the sh., "there arose a terrible wind."
2545. *Cleckheaton*.—Anon. 6. 4. 7. a noise as of a very sudden storm arising, f. imm. by a tremendous rumbling, like that of a heavily freighted train, wh. shook the house and the bed. b. p.
2546. Do.—(*Bradford Observer Budget*, Dec. 19.) 6. 5.
2547. *Crackenedge*.—Mr. H. A. Ellis (*Dewsbury District News*, Dec. 19.) 3. ab. 5.32. 4. a rocking of the house.
2548. *Crosland Edge* (near Huddersfield).—(c. by Mr. C. L. Brook.) 3. 5.39 or 5.40. 4. 2 vibra. 6. pr. 4.
2549. *Crosland Hall* (do.).—Mr. G. T. Porritt, F.C.S.† 3. 5.30. 6. 5. 7. no.
2550. *Deighton*.—Miss F. B. Han.* 3. bet. 5 and 6. 5. ab. 3 secs.
2551. *Delph*.—Mr. C. F. Roberta 3. ab. 5.30. 4. an unusual rattling of windows; f. after 2 or 3 secs. by 6 horizontal oscillations. g. N. and S. 5. ab. 4 secs. 6. 4.
2552. *Dewsbury*.—Mr. A. Ridgway.† 3. 5.33. 4. trem. mot. 5. ab. 7 secs. 6. 4. 7. no.
2553. Do.—(*Dewsbury District News*, Dec. 19.) 4. the houses trembled as when a heavy dray is passing. 6. 4.
2554. Do.—Mr. Craven† (Do.). 3. 5.32. 4. the bed rocked from side to side. g. E. to W. 6. 5? 7. the sh. was p. by a noise as of rushing wind through a small aperture.
2555. *Doncaster*.—Mr. H. E. Sykes† 3. ab. 5.25. 4. f. yea. 5. ab. 15 secs. 6. 5. 7. as if a heavy traction-engine were passing down the street (according to another obs.).
2556. Do.—Dr. J. Sykes† (c. by Mr. H. E. Sykes). 3. ab. 5 or 6. 4. ab. 6 shakes up and down. 6. pr. 5.
2557. Do.—(c. by Rev. W. L. Wilson.) 4. as if a traction-engine were going quickly along the street.
2558. Do.—(*Yorkshire Herald*, York, Dec. 18.) 3. bet. 5 and 6. 6. 4.
2559. *Fangfoss*.—Mrs. Eaden† 6. pr. 4.
2560. *Far Headingley*.—(*Leeds Mercury*, Dec. 19.) 3. 5.35. 4. two shs. felt in rapid succession. 6. 5? 7. a rumbling so.
2561. *Flamborough Lighthouse*.—Mr. T. A. Lawrence.* 4. the motion similar to that caused by gales or heavy squalls of wind. e. beg., and then died away. 5. 2 or 3 secs. 7. no.
2562. *Fulford*.—(*Yorkshire Herald*, York, Dec. 19.) 3. ab. 5. 6. 5? 7. a rushing so. like that made by the approach of a storm; imm. afterwards the sh. was felt.
2563. *Goole*.—Mr. A. E. Hodgson. 3. ab. 5.30. 5. pr. 15 or 20 secs. 6. 5. 7. a long string of heavy springless waggons passing.

2564. *Halifax*.—J. Forrer (c. by Mr. C. B. Holdsworth). 3. ab. 5.30. 4. the vibra. of the same int. 5. 3 secs. 6. 4. 7. no.
2565. *Harrogate*.—Mr. J. P. Lewis. 3. 5.30. 4. a slight vibr. 5. ab. 20 secs. 7. a so., like the rumbling of a waggon, acc. the sh.
2566. Do.—Anon.* (c. by J. Ellis). 3. ab. 5.30. 6. 4. 7. a roar as of wind in the chimney. b. p.
2567. Do.—H. I. Proctor.† 3. 5.30. 4. the bed oscillated very quickly from E. to W. 6. 4.
2568. Do.—E. Parker.† 6. 4.
2569. Do.—Mr. G. Paul (*Yorkshire Post*, Leeds, Dec. 18). 3. 5.32½. 4. g. W. to E. 5. ab. ½ min. 7. a rumbling so.
2570. Do.—(*Darlington and Stockton Times*, Darlington, Dec. 19.) 4. g. W. to E. 6. < 4. 7. a series of sounds, like slight explosions, acc. the sh. and died away with it.
2571. Do.—(*Bradford Observer Budget*, Dec. 19.) 4. two upheavals. 6. 4?
2572. Do.—(*Yorkshire Herald*, York, Dec. 18.) 3. 5.30. 6. 4.
2573. *Harrop*.—(*Craven Herald*, Skipton, Dec. 18.) 4. sh. distinctly felt.
2574. *Healey House* (near Huddersfield).—(c. by Mr. C. L. Brook.) 4. sh. felt.
2575. *Hebden Bridge*.—Mr. J. Needham. 3. 5.35. 4. a. slight, 1 sec. b. one prin. vibr. [or series] ab. 2 secs. d. yea. 5. 3 secs. 6. pr. 5. 7. distant thunder, or a waggon going over a macadamised road. d. yes; the so. had ended when the vibr. was felt.
2576. *Heeley*.—Mr. J. Hall (*Sheffield Daily Telegraph*, Dec. 18). 5. some secs. 6. < 4. 7. the howling of wind, f. by the tremor.
2577. *Hellifield*.—Mr. J. Lambert.* 3. 5.35. 4. only one sh. g. S. to N. 5. 2 to 3 secs. 6. pr. 4. 7. a rushing kind of so., like that of a waterfall heard from a distance. b. f. ab. 1 sec.; the so. appeared to travel from S. to N.
2578. *Howden*.—(c. by Mr. J. S. Fitch.) 3. 5.30 to 5.45. 4. 2 shs., the first more severe, separated by an interval of a few secs. 6. 5. 7. no.
2579. *Huddersfield*.—Mr. S. Learoyd.† 3. ab. 5.35. 4. g. N. to S. 5. ab. 6 or 8 secs. 7. no.
2580. Do.—(*Bradford Observer Budget*, Dec. 19.) 6. 4.
2581. *Hunslet*.—Mr. J. Clough* (*Yorkshire Post*, Leeds, Dec. 18). 3. ab. 5.25. 4. the bed shook violently, and the jug in the wash-hand basin rocked from side to side nearly a dozen times.
2582. *Ilkley*.—Mr. F. Reynolds† 3. 5.33. 6. 5? 7. a high wind in the chimney. b. p. c. p.
2583. Do.—(*Darlington and Stockton Times*, Darlington, Dec. 19.) 4. several persons were disturbed by the rattling of ornaments and a rocking sensation.
2584. *Ingrow*.—Miss M. A. Clough.† 3. ab. 5.30. 4. f. no. 5. ab. 4 secs. 6. 5? 7. people going to work heard a slight rumbling noise.
2585. *Kirk Sandal*.—Anon.* (*Yorkshire Post*, Leeds, Dec. 19). 3. 5.30. 4. 3 shakes or liftings of the bed. 6. 4 or 5.
2586. *Leeds*.—(c. by Mr. J. P. McNaughton.) 3. ab. 5.30. 4. the bed rose 3 times in succession at intervals of 3 or 4 secs.

2587. Do.—(*Leeds Mercury*, Dec. 18.) 3. ab. 5.30. 4. a trembling movement. 6. 4.
2588. Do.—Mr. J. L. Micklethwait † (*Yorkshire Post*, Leeds, Dec. 19.) 4. an unpleasant swaying of the bed. 6. 5?
2589. *Middlesborough*.—Rev. H. Bealey * (*Northern Daily Mail*, Hartlepool, Dec. 18.) 4. the bed rocked from side to side. 5. ab. 5 secs.
2590. *Mytholmroyd*.—Mr. W. H. Skelton. 3. 5.34½.* 4. one regular series of vibra, too rapid to count. g. E. and W. 5. 5 or 6 secs. 6. pr. 4. 7. no.
2591. *Netherton*.—(c. by Mr. C. L. Brook.) 4. 2 vibra. 7. yes.
2592. *Newhill*.—Miss A. Payne. 3. ab. 5. 4. one series only. 5. several secs. 6. 4. 7. the so. f. the sh. imm.
2593. *Northallerton*.—Mr. W. S. Charlton. † 3. ab. 5.30. 4. 2 series of vibra. 5. ab. 10 or 12 secs. 6. 4.
2594. *Otley*.—(*Darlington and Stockton Times*, Darlington, Dec. 19.) 4. the rattling of ornaments and a general sensation of rocking.
2595. *Richmond*.—Anon. † (c. by Mr. H. A. Robinson). 3. bet. 5 and 5.30. 6. 4. 7. no.
2596. Do.—Mr. N. Robinson (*Darlington and Stockton Times*, Darlington, Dec. 19.) 3. ab. 5. 6. 4. 7. the sh. acc. by strange subterranean noises.
2597. Do.—Mr. Matchell * (Do.). 4. the bed shook.
2598. *Ripon*.—E. Kearsley. 3. ab. 5. 4. 2 shs., the first stronger. 5. a few secs. 6. 4. 7. distant thunder: the so. p. the sh. entirely.
2599. *Sheffield*.—Mr. A. Hill * 3. 5.32. 4. the bed was lifted and jerked to the N. and back again to the S. with an oscillating motion. 5. 3 to 4 secs. 6. 5. 7. no, but another obs. heard a rumbling so. like that of stone carts going down the hill.
2600. Do.—Mr. J. Barber. 3. bet. 5.35 and 5.40. 4. two distinct parts, the first very slight and the second much stronger, interval bet. them not more than 2 secs.; the first sh. momentary, the second lasting ab. 5 secs. 6. 5? 7. no.
2601. Do.—Mr. W. May. 3. 5.33. 4. only one sh. 5. ab. 2 secs. 6. 5. 7. no.
2602. Do.—Rev. R. G. Pyne * (c. by Mr. E. Howarth). 3. ab. 5.30. 4. the bed shook with a quick oscillating motion. g. N. and S. 5. ab. 1½ or 2 secs. 6. < 4.
2603. Do.—Mr. A. H. Allen † (Do.). 4. a double sh. 6. pr. 5.
2604. Do.—Mr. H. Himsworth * (Do.). 3. ab. 5.30. 4. the bed suddenly rocked from W. to E. 6. 5.
2605. Do.—Mr. A. Davey.* 3. bet. 5.34 and 5.35. 4. one continuous tremor, but varying in int. 5. 3 or 4 secs. 6. 4. 7. no.
2606. Do.—Mr. G. Bromley. † 3. 5.25. 5. 2 or 3 secs. 6. 4.
2607. Do.—(*Sheffield Daily Telegraph*, Dec. 18.) 3. 5.32. 5. 15 secs. 6. < 4.
2608. Do.—Mr. E. Howarth, F.R.A.S. † (Do.). 3. ab. 5.30. 4. a loud rattling noise in the room for ab. 2 secs., it ceased momentarily, and was then repeated, but not so loudly, for ab. 1½ secs. 6. < 4.
2609. Do.—Mr. G. W. Parker * (Do.). 3. ab. 5.30. 4. the floor seemed to bend, then the bed was jerked thrice; in continuation of this, the

windows were violently shaken from 7 to 9 times. 6. pr. 5. 7. after the sh., there was a very faint rumbling noise.

2610. *Shipley*.—Anon.† (c. by Mrs. Fyfe). 3. 5.30. 4. the bed rocked, as if some one were underneath it, lifting it up; one sh. only. 6. pr. 5.

2611. *Skircoat*.—Mr. C. T. Rhodes. 3. bet. 5.30 and 5.40. 4. the bed moved. 7. yes.

2612. *Snaitth*.—Rev. E. Storrs Fox.† 3. ab. 5.38. 4. 2 distinct shs., the first more severe and longer. 6. pr. 5.

2613. *Stainforth*.—Mr. W. Prior.* 3. ab. 5.30. 4. only one sh. 5. ab. 40 secs. 6. 4. 7. a sudden gust of wind. b. f. imm.

2614. *Tadcaster*.—(*Wetherby News*, Dec. 26.) 4. sh. distinctly felt.

2615. *Terrington*.—Anon.* (c. by Dr. J. Dougall). 3. 5.30. 4. 2 series of vibra., with a short pause bet. 6. pr. 4. 7. no, but heard by another obs.

2616. *Thorpe* (near Halifax).—Mr. F. G. S. Rawson (*Halifax Courier*, Dec. 19). 3. 5.30 to 5.35. 5. ab. 4 secs. 6. 5?

2617. *Todwick*.—Mr. W. Stainforth.* 3. 5.30. 5. < 3 secs. 6. pr. 4. 7. like snow slipping from a slated roof, but not quite so loud.

2618. *Wath-on-Dearna*.—Anon.* (c. by Dr. H. Payne). 3. ab. 5.30. 4. only one sh. 6. 4. 7. no.

2619. *Welburn*.—(c. by Dr. J. Dougall) 3. ab. 5.30. 4. slight trem. mot. like the shaking of a house caused by a traction-engine passing; repeated after a short interval, as if the engine were returning after having gone a few yards. 6. 4. 7. a traction-engine passing; the so. seemed to coincide with the vibra.

2620. *West Vale* (near Halifax).—(*Halifax Courier*, Dec. 19.) 3. ab. 5.30. 6. 5? 7. a rumbling noise.

2621. *Wetherby*.—(*Wetherby News*, Dec. 24.) 4. the sh. was felt by two persons.

2622. *Woodhouse* (near Leeds).—Mr. J. H. Chappelow † (*Yorkshire Post*, Leeds, Dec. 19). 3. ab. 5.33. 4. 2 shs., the first stronger, scarcely one min. bet. them. 6. pr. 4.

2623. *York*.—Miss E. S. Barry.† 3. shortly after 5.30. 4. an upheaval of the bed, f. by a rocking to and fro. 5. ab. 4 or 5 secs. 7. no.

2624. Do.—(*Yorkshire Herald*, York, Dec. 19.) 3. ab. 5.30. 4. a distinct tremor.

2625. Do.—Mr. J. C. Chapman (Do.). 3. 5.30. 6. 4.

2626. Do.—Rev. W. Haworth * (Do.). 3. ab. 5.33. 4. a distinct trem. shaking of the bed.

2627. Do.—Anon.* (Do.). 3. 5.30. 4. the bed moved as though something were underneath.

2628. Do.—Mr. M. Cooper † (Do.). 3. ab. 5.30. 4. more an upheaving motion than a tremor. 5. a few secs. 7. the sh. acc. by a rumbling noise.

DURHAM

There can be little doubt that the earthquake in this county must have been strong enough to be perceptible to persons who were awake at the

time. I have, however, received no certain record of the fact. Nearly every newspaper refers to a case of supposed damage to a wall at West Hartlepool. "At an early hour a brick wall behind Mr. Walter Seal's shop in Church Street sank considerably without any apparent cause. Part of the foundations had subsided, so that the supposition that this is owing to seismic disturbance is not an unlikely one" (*Northern Daily Mail*, Hartlepool, Dec. 17). But when we think how slight the tremor must have been at this place, it is clear that the occurrence of the damage on the same morning as the earthquake must have been a mere coincidence. Several persons believe that they either felt the shock or heard the sound, but the evidence in my possession is far from conclusive on this point.

NORTHUMBERLAND

2629. *Acklington* (near Warkworth).—Mr. T. Forster. 3. ab. 5.25. 5. ab. 4 or 5 secs. 6. \rightarrow 3. 7. a distinct boom wh. lasted ab. 2 secs.; a noise like distant thunder also c. with and f. the vibr.

This is the only record I possess from this county. It may refer to some other disturbance, but, except the isolation of the place of observation, I see no reason for supposing this to be the case.

CUMBERLAND

I have received no records whatever from this county.

WESTMORELAND

2630. *Grasmere*.—Anon. (c. by Mrs. Jackson). 3. ab. 5.30 A.M. 4. the bed oscillated twice unmistakably, with a sec. or two bet. the movements. 7. no. (Many persons in the village were awakened at the time, though they felt and heard nothing.)

2631. *Kendal*.—(c. by Mr. G. F. Bates.) 3. just after 5.30. 4. two distinct sha., the second apparently the stronger: the interval bet. them only a very few secs. 5. ab. 12 secs. 6. pr. 4. 7. distant thunder, or a steam-roller or traction-engine at some distance; the so. appeared to c. exactly with the sha. (Two other persons in the town felt the eq.)

LANCASHIRE

2632. *Aigburth*.—Mr. W. J. Yeoman † (*Liverpool Courier*, Dec. 18). 3. 5.35 A.M. 4. a regular, well-defined movement, the sensation, not an unpleasant one, being of the soft undulating character experienced in a coach with good springs. 5. 10 to 15 secs. 6. 5.

2633. *Barrow-in-Furness*.—Mrs. J. Clarkson.* 3. 5.34 or 5.35. 6. 3. 7. pressing her head to the pillow, the obs. heard a rumbling noise like the grating of a boat on a beach.

2634. Do.—Rear-Admiral J. B. Barnett. 3. 5.30. 4. a slight vibr., only one sh. 5. ab. 3 or 4 secs. 6. pr. 3.

2635. *Blackburn*.—Mr. F. Pafford.* 3. ab. 5.25. 4. only one sh. 5. 2 or 3 secs. 7. no.

2636. Do.—Miss E. Pafford. 4. a quiver of the bed. g. E. to W., roughly. 5. 1 to 3 secs. 7. no rumbling so., but a comparatively slight gust of wind imm. p. the sh.

2637. Do.—(*Liverpool Daily Post*, Dec. 18.) 3. 5.36. 5. ab. 10 secs. 6. < 4.

2638. *Blackpool*.—(*Blackpool Herald*, Dec. 18.) 3. ab. 5.30. 6. 5?

2639. Do.—Mr. E. Mapple (Do.). 4. three distinct vibra. g. N.E. to S.W. 6. < 4.

2640. *Blackrod*.—Anon.* (c. by Mr. J. Unsworth). 3. 5.34. 4. ab. 5 vibra., f. by trem. mot. g. N. to S. 5. ab. 4 to 5 secs. 6. pr. 5. 7. an interval of ab. 2 secs. f. the sh. and then a so. was heard like a traction-engine passing; the noise lasted ab. 3 to 5 secs. and was very loud and distinct.

2641. *Blundellsands*.—Anon. 3. 5.32. 4. the bed steadily and regularly shaken five times from N. to S. 5. 4 secs. 6. 5. 7. a rushing so., like heavy wind pressing against the house, c. with the sh.

2642. Do.—“H. C.” (*Liverpool Courier*, Dec. 18). 3. ab. 5.35. 4. the bed rocked gently.

2643. *Bolton*.—Mr. F. H. Matthews† 4. a swinging motion of the bed from side to side, i.e. E. and W. 6. 5. 7. a very distinct so. acc. the sh.

2644. Do.—Rev. T. Taylor-Evans† (*Bolton Chronicle*, Dec. 19). 4. two sha. 7. a rushing so. like wind, then a rumbling so., f. closely by a noise like that of an explosion; this acc. the first sh.

2645. Do.—(*Liverpool Daily Post*, Dec. 18.) 3. ab. 5.35. 4. a short but sharp series of vibra., four distinct tremors counted. 6. < 4.

2646. *Bootle*.—Mr. S. J. Mowbray† 3. 5.34. 4. the bed rocked and twisted in a curious manner. 5. 10 to 12 secs. 6. 6. 7. a heavy waggon travelling at a smart pace over a wooden bridge.

2647. Do.—Mr. W. B. Brown.* 3. 5.30 or 5.35. 4. the motion like that made by a traction-engine passing, but more intense; no rocking or swaying. d. yes. 5. ab. 4 secs. 6. 5? 7. a traction-engine passing, but not so loud.

2648. *Burnside*.—Anon.† (c. by Mr. S. Jackson). 3. ab. 5.30. 4. g. N. to S.

2649. *Caldershaw*.—Mr. C. Heap.* 3. ab. 5.35. 4. the first sh. (as if some one had fallen downstairs) was quickly f. by a wavy trembling motion from N. to S. 5. ab. 7 to 10 secs. 6. 5. 7. a dull rumbling so.

2650. *Chorlton-cum-Hardy*.—Miss Adshead.* 3. 5.34. 4. first a slight trembling, then suddenly the bed rocked 3 or 4 times, and imm. afterwards the windows shook violently; after this had ceased, a more prolonged tremor was again felt. g. S.S.W. to N.N.E. 5. 10 to 15 secs. 6. 5.

2651. Do.—Mr. H. Whale (*Manchester Courier*, Dec. 18). 3. 5.35. 4. a well-defined upheaval and vibratory motion. 5. ab. 5 secs. 6. 5. 7.

the sh. acc. by a rushing and rumbling so. as if a steam-roller had passed rapidly through the cellar.

2652. *Chorlton-on-Medlock*.—Mr. H. Walker.* 3. ab. 5.30. 4. the motion like that felt in a boat off shore very suddenly rising over a slight ground-swell broadside on. g. N. to S. 5. ab. 3 secs. 6. 6? 7. a so., like that of a sudden gust of wind striking the house, p. the sh.; interval of ab. a sec. between them.

2653. *Didsbury*.—Dr. B. Hobson, F.G.S. 3. 5.35½. 4. a gentle swinging motion. g. pr. N. and S. 6. pr. 5.

2654. Do.—A. M. Lucas† 3. 5.39. 4. the bed gently pitched up and down three times, and this was acc. all the time by a quivering motion, wh. continued afterwards for ab. half a minute. 6. 5. 7. no.

2655. Do.—Anon.* (c. by A. M. Lucas). 3. ab. 5.35. 6. < 4. 7. a curious rumbling like three loud explosive moans rolling beneath the earth, ending in a great thud, ab. a sec. after wh. the windows rattled.

2656. Do.—Mrs. Galland. 3. 5.30. 7. four swishing sounds, like heavy snow-falls from the roof, following one another quickly.

2657. Do.—Mr. E. Kyllmann.* 3. 5.35. 4. a smart sh. from ab. N. to S.

2658. Do.—(*Manchester Courier*, Dec. 18.) 3. ab. 5.35. 4. two distinct and violent sha. 6. pr. 5.

2659. *Eccles*.—Mr. T. A. Bedale.† 3. ab. 5.31. 5. ab. 8 secs. 6. 5. 7. no.

2660. Do.—Mr. C. T. Ashworth.† 3. 5.29. 4. the jug rattled in the basin ab. 10 times. 5. nearly 10 secs. 6. 5.

2661. *Fallowfield*.—Mr. A. J. Bennett.* 3. 5.35. 4. 2 oscillations from S. to N., the bed rising each time, but slightly less the second time. 5. ab. 10 secs. 6. 5. 7. a so. as of a rushing force p. the oscillations by a few (perhaps 10) secs., but no rumbling so. heard.

2662. Do.—(*Manchester Guardian*, Dec. 18.) 4. the bed oscillated 4 or 5 times. g. N. and S.

2663. *Garstang*.—Mr. S. Wilson* (*Symons' Meteorological Magazine*, vol. 31, 1897, pp. 180-181). 3. ab. 5.35. 5. 6 to 10 secs. 6. 4.

2664. *Glodwick*.—Rev. G. J. Watta† 3. ab. 5.30. 5. 3 or 4 secs.

2665. *Heaton Chapel*.—Mr. T. Rogerson, jun.† 3. bet. 5.30 and 5.32. 4. swinging hammock-like motions, steady and even, perhaps 3 in number. g. N. and S. 5. ab. 6 secs. 6. 5. 7. no.

2666. *Heaton Mersey*.—Ald. Hoy (*Manchester Guardian*, Dec. 18). 4. 3 or 4 rather prolonged jerks, the first most pronounced.

2667. *Heaton Norris*.—Anon.† (c. by Mr. T. Rogerson, jun.) 3. bet. 5.30 and 5.35. 4. a swaying undulatory motion of the bed. 6. 5.

2668. *Hulton Park*.—Ald. W. W. B. Hulton, J.P.* 3. ab. 5.35. 4. 4 distinct throbs. 6. < 4.

2669. *Huyton Junction*.—Mr. H. Hulme.* 6. < 4.

2670. *Ince Blundell*.—Mr. J. Rainford (*Liverpool Daily Post*, Dec. 18). 3. ab. 5.25. 6. 4 windows on the ground floor were broken into pieces; the walls of the house trembled perceptibly. 7. a loud rumbling noise [the eq. was acc. by remarkably vivid flashes of lightning].

2671. *Leigh*.—Anon.* (c. by Rev. J. H. Stanning). 3. soon after 5.30. 4. the bed moved slightly.

2672. *Levenshulme*.—Miss W. Faraday.* 3. 5.35. 4. a. yes, 2 or 3 secs. b. 3 prin. vibra., ab. 5 secs. c. yes, 8 to 10 secs. d. yea. e. beg. f. yea. 5. ab. 15 secs. 6. 6; pictures swung; the bookcase, washstand, etc., were shaken forwards, and things standing on them moved forward 2 or 3 ins.

2673. Do.—(*Altrincham Chronicle*, Dec. 18.) 4. as if some one heaved up the bed and let it drop. 6. 5.

2674. *Liverpool*.—Mr. D. F. Williams† (c. by Mr. J. Lomas). 3. ab. 5.33 to 5.35. 4. only one sh., the bed seemed to be raised and then lowered. g. E. and W. 5. ab. 60 secs. 6. 5. 7. a rumbling noise.

2675. Do.—L. Maughan.* (c. by Mr. J. Lomas). 3. bet. 5 and 6. 4. a slight rising and then a rolling from side to side several times. g. ab. N. and S. 6. 5. 7. no.

2676. Do.—Mr. T. R. Bradshaw† (c. by Mr. J. Lomas). 3. ab. 5.30. 4. the bed oscillated rapidly from side to side, perhaps 2 or 3 times each way, through an arc of ab. 2 ins.; the sensation like the swaying of a house in a gale. g. E. and W. 5. ab. 2 secs. 6. 5. 7. no.

2677. Do.—Rev. T. W. M. Lund† (*Liverpool Courier*, Dec. 18.) 3. 5.35. 4. an oscillating movement. g. pr. E. to W. 5. some secs. 6. < 4.

2678. Do.—Mr. C. Laycock (*Liverpool Courier*, Dec. 21). 3. bet. 5.30 and 6. 4. g. W. to E. 5. ab. 13 secs. 6. 5 or 6.

2679. Do.—Prof. O. J. Lodge, F.R.S.* (*Liverpool Daily Post*, Dec. 18). 3. 5.30. 4. a triple horizontal tremor and a slight upheaval.

2680. Do.—Mr. S. Cameron (*Liverpool Daily Post*, Dec. 18). 4. two distinct shs., the first ab. 6 secs., a pause of 2 secs., and then another less intense vibr. of ab. 3 secs.

2681. Do.—Mr. A. H. Bedell† (*Liverpool Mercury*, Dec. 18). 3. ab. 5.30. 5. ab. 2 secs. 6. < 5.

2682. Do.—(*Liverpool Courier*, Dec. 18.) "In a number of instances, the vibration caused ornaments to fall from mantelpieces, and pictures and crockery were also displaced. In the Telephone Exchange, the operating boards were violently shaken and a large number of the indicators dropped."

2683. *Longridge*.—Rev. T. M. Harrison.* 3. ab. 5. 4. a trem. mot. 7. no.

2684. *Longsight*.—(*Manchester Courier*, Dec. 18.) 4. the bed appeared to sink several inches and to rise again with a jerk. 5. ab. 20 secs. 6. 5.

2685. *Lostock Park*.—Mr. W. Golding (*Bolton Chronicle*, Dec. 19). 3. 5.34. 6. < 4.

2686. *Lower Darwen*.—Mr. W. Botwright.* 3. 5.33. 4. one sudden sh. 6. 4. 7. no.

2687. *Lytham*.—Mr. T. Tair, J.P. 3. 5.35. 4. 3 shs. in imm. succession, a slight vertical motion, with a rolling of the bed from E. to W. 6. 5. 7. no.

2688. *Maghull*.—(*Liverpool Daily Post*, Dec. 18.) 3. ab. 5.30. 5. ab. 6 secs. 6. pr. 5.

2689. *Manchester*.—Miss E. S. Laverty.* 3. bet. 5.20 and 5.25. 4. the foot of the bed (towards the N. or N.W.) was tilted up 10 or 12 times in quick succession, f. by 3 more tilts with short intervening pauses, the last much slighter than the others and more of a tremor. 6. 5. 7. imm. before

the sh. began, the obs. heard a so., but did not notice whether it was made by a passing vehicle or not.

2690. Do.—Miss Gaskell. 3. ab. 5.35. 4. the room rocked violently 3 or 4 times from N.E. to S.W. 5. ab. 10 secs. 6. 5. 7. no.

2691. Do.—Mr. V. Leaton.† 4. the bed was jerked or pushed quickly twice, the movement being apparently half an inch, the interval bet. the jerks one sec. f. no. g. W.N.W. to E.S.E. 6. 5. 7. no.

2692. Do.—Mrs. Tyler. 3. ab. 5. 6. 5. 7. a very deep rumbling, f. by a trembling.

2693. *Moston*.—Mr. J. Kay.† 3. bet. 5.30 and 6. 6. < 5.

2694. *Nelson*.—Mr. J. W. Ratcliffe. 3. ab. 5.33 or 5.34. 4. 4 vibra. 5. 8 or 10 secs. 6. 5? 7. no.

2695. *Newton-le-Willows*.—(*Liverpool Daily Post*, Dec. 18.) 6. < 4.

2696. *Old Trafford*.—(*Manchester Courier*, Dec. 18.) 5. ab. 15 secs. 7. the sh. was acc. by a slight rumbling so.

2697. *Ormskirk*.—Mr. F. A. Jones† (c. by Mr. J. Lomas). 3. 5.30. 4. the bed shook 2 or 3 times from ab. N. to S. 7. no.

2698. *Pendleton*.—Mr. J. Anderton.* 3. 5.32. 4. the bed was lifted 3 times, like a ship at sea when a swell passes under, only more rapidly; no trem. mot. 5. ab. 3 secs. 6. 5. 7. no.

2699. Do.—M. E. Trevelyan. 3. 5.35. 4. 2 swinging movements N.W. and S.E.; no trem. mot. 5. ab. 2 or 3 secs. 6. 5. 7. no.

2700. Do.—Mr. J. Dickinson.* 4. a tremor like that made by a road-engine passing over a deep sandy subsoil. 5. ab. 20 secs.

2701. *Pennington* (near Ulverston).—Mr. R. Redfern. 3. 5.30. 6. 4?

2702. *Pleasington*.—Mr. F. T. Marwood, J.P.† 3. ab. 5.35. 4. there being a good light in the room, the obs. distinctly saw the room rock and wave to and fro from S. to N.; the crockery on the marble slab of the washstand rattled very loudly, and afterwards the bed trembled for ab. 10 secs. 6. 5.

2703. *Preston*.—Mr. R. Seed.† 3. ab. 5.30. 4. a pleasant, gentle, but powerful rocking of the bed. 5. ab. 10 secs. 6. 5. 7. no.

2704. Do.—(*Standard*, Dec. 18.) 7. the sh. was acc. by a low rumbling so. as of distant thunder.

2705. *Rusholme*.—Mr. J. S. Pritchard.* 3. 5.30. 4. the house trembled. 5. ab. 5 to 6 secs. 7. the so. was not a rumbling, but a tremulous noise; after the trembling a so. was heard as of the falling of great stones into an unfathomable abyss.

2706. *St. Helens*.—(*Liverpool Daily Post*, Dec. 18.) 3. ab. 5.30. 6. < 4.

2707. *Salford*.—(*Manchester Courier*, Dec. 19.) 6. 5.

2708. *Sefton Park*.—Anon.* (c. by Mr. J. Lomas). 3. 5.33. 4. rippling waves from W. to E. 5. ab. 5 secs. 7. no.

2709. *Southport*.—Mr. H. M. Longshaw.* 3. bet. 5.30 and 5.35. 4. a trembling or shivering motion, but not a wave-like motion. f. no. 5. ab. 30 secs. 6. < 4. 7. no.

2710. Do.—Mr. C. James. 3. ab. 5.30. 6. < 4. 7. a sudden rushing noise, like a violent gust of wind, p. the sh.

2711. Do.—(c. by Mr. T. P. C. Williams.) 3. 5.33. 5. estimates vary from 10 to 30 secs. 7. some persons were wakened by the so.

2712. Do.—Mr. Bilderbeck (c. by Mr. J. Lomas). 3. 5.30. 4. the bed rocked. g. E. to W. 6. 5.

2713. Do.—(*Liverpool Courier*.) 3. 5.30. 5. ab. 15 secs. 6. 4 5.

2714. *Stretford*.—Mr. J. D. Sutcliffe. 3. 5.35. 4. as though some one took hold of the W. side of the bed and shook it sideways; 3 distinct parts, separated by pr. 3 or 4 secs, the first part strongest and longest. g. E. and W. 6. 5. 7. no.

2715. Do.—(*Altrincham Chronicle*, Dec. 18.) 6. 5.

2716. *Ulverston*.—Miss F. M. Haines. 3. 5.35. 4. 2 shs., of wh. the second was the more violent and f. imm. on the first. 7. wind blowing strongly through trees.

2717. *Walkden*.—Mrs. C. Heath.† 3. 5.40. 4. wakened by the shaking of the bed.

2718. *Walton*.—M. J. Williams. 3. 5.35. 4. a rocking to and fro of the bed; two series, the first stronger, ab. 4 or 5 secs. bet. them. 5. 10 to 12 secs. 6. 5. 7. no.

2719. *Warrington*.—Rev. F. W. Willis† 3. 5.40. 4. a gentle upward and downward motion of the bed. 5. ab. 5 secs. 6. pr. 5; a hand-screen on the mantelpiece fell down.

2720. Do.—(*Liverpool Courier*, Dec. 18.) 3. 5.23. 5. ab. 3 secs. 7. the sh. was p. by a violent peal of thunder.

2721. Do.—(*Daily Chronicle*, Dec. 18.) 3. 5.30. 6. 4. 7. a rumbling noise.

2722. *Waterloo*.—Mr. J. M. Dow.† 3. 5.35. 5. 12 secs.* 6. 5? 7. no.

2723. *West Didsbury*.—Mr. R. Marsden.* 3. bet. 5.30 and 5.40. 4. a sharp shake was suddenly given to the bed; the movement was not undulatory, but seemed to consist of 4 lateral pushes backwards and forwards. g. N.N.E. to S.S.W. 5. ab. 3 or 4 secs. 6. pr. 5. 7. no.

2724. *Whalley Range*.—Mr. G. H. Bailey.* 4. the house rose and fell and vibrated. 6. 5. 7. a rush of wind, f. by a roar, and then the so. of wind passing onwards; after an interval, the sh. was felt.

2725. *Widnes*.—(*Liverpool Courier*, Dec. 18.) 4. sh. felt.

2726. *Wigan*.—(*Wigan Observer*, Dec. 18.) 3. ab. 5.30. 6. 5. 7. many persons were wakened by what appeared to be the report of a colliery explosion.

2727. *Withington*.—Miss M. Gerard.* 3. ab. 5.30. 4. the house trembled, but there was no upheaval. 5. ab. 12 secs. 7. no.

2728. Do.—(*Altrincham Chronicle*, Dec. 18.) 3. ab. 5.30. 6. 5?

2729. *Worthington*.—Mr. W. S. Kinch.* 3. 5.33. 4. 3 distinct vibrs. [series?] from W. to E. f. no. 5. ab. 10 secs.* 6. 5. 7. no.

ANGLESEY

2730. *Beaumaris*.—Mr. Mills † (c. by Mr. E. Greenly). 3. ab. 5.30 A.M. 4. apparently prin. vibra. only. g. S.E. to N.W. 5. quite short. 6. 5? 7. no.

2731. Do.—(*N. Wales Chronicle*, Bangor, Dec. 19.) 4. a sharp sh., most severe near the sea-side.

2732. *Bethel*.—(c. by Mr. E. Greenly.) 4. sh. felt by 3 persons.

2733. *Bodorgan*.—Mr. D. Roberts (Do.). 3. 5.35. 4. 2 prominent vibra., with a continuous trem. mot. bet. f. no. 5. 10 or 12 secs. 6. 5. 7. in connexion with the prin. vibra., there was a low rumbling so., like that of a heavy railway-train passing through a tunnel, and culminating in a loud report, or rather thud, as of a heavy body falling on a carpeted floor.

2734. Do.—Mr. Gray (Do.). 4. g. S.E. to N.W.

2735. *Llanfair-pwllgwyngyll*.—Anon.† (Do.). 6. 4. 7. a post-cart passing along the road; at the same time as the sh.

2736. *Llangoed*.—Rev. M. Griffith (Do.). 3. 5.30. 4. a slight tremor. 5. 2 or 3 secs.

2737. *Malltraeth Yard*.—Mr. J. Russell † (Do.). 3. 5.30. 4. 3 distinct upheavals, f. by oscillation. e. beg. 6. 5; a watch on the dressing-table stopped at 5.30. 7. no.

2738. *Menai Bridge*.—Mr. Jones (Do.). 4. several undulations.

2739. *Pentraeth*.—Rev. L. Howell † (Do.). 5. 6 secs. 6. 5. 7. yea. b. p.

2740. *Plas Llanfair*.—Anon.† (Do.). 3. 5.30 to 5.45. 4. ab. 3 or 4 vibra. felt, grad. increasing in int., not more than $\frac{1}{4}$ sec. bet. each pair. g. N. and S. 5. ab. 2 secs. 6. 4: "a large slate cistern in the roof containing 400 gallons began to leak soon after and cracks are found in the side, but it is uncertain if they were caused by the eq."

2741. *Plas Tregayan*.—Mrs. Lloyd † (Do.). 3. 5.35. 4. a continuous movement, steadily increasing in int. e. mid. f. no. g. S.E. to N.W. 5. ab. 30 secs. 6. 5. 7. no.

CARNARVONSHIRE

2742. *Aber*.—(*N. Wales Chronicle*, Bangor, Dec. 19.) 4. sh. felt.

2743. *Aberdunant*.—Mrs. Jones-Parry † (c. by Mr. E. Greenly). 3. 5.32. 6. 4; a small book, put on a stand to shade a night-light, fell down.

2744. Do.—Anon. (Do.). 3. 5.30. 4. the bed trembled and then heaved up.

2745. *Abersoch*.—(c. by Mr. C. S. Dennis.) 6. 5. 7. no.

2746. *Afon Wen*.—Mr. R. Williams (Do.). 3. ab. 5.38. 4. one series. 5. ab. 50 secs. 6. 5. 7. as if blowing in a gale.

2747. *Bangor*.—Dr. E. T. Jones (c. by Mr. E. Greenly). 3. 5.35. 4. a. no. b. 4 or 5 horizontal vibra. c. no. d. the movement apparently uniform in int., beginning and ending suddenly. 5. 2 or 3 secs. 6. pr. 5. 7. no.

2748. Do.—Mr. G. J. Williams, F.G.S.* (Do.). 3. 5.30. 4. d. yea. e. mid. g. S.E. to N.W. 5. 4 or 3 or 4 secs. 6. 5. 7. no.

2749. Do.—Mr. Glynne Williams † (Do.). 4. one series, ending suddenly. 6. 5. 7. heavy carts passing. b. c. c. c.

2750. Do.—Miss G. Ellis* (Do.). 4. the movement was a rapid rocking one, not backwards and forwards, but in one direction, from E. to W.; it

began and ended without any change in int. and period. f. yes. 6. 5. 7. muffled thunder; the end of the so. p. the vibra. d. no; the so. appeared to travel from E. to W.; duration of so. and vibra, 5 secs.*

2751. Do.—Mr. J. Thomas † (Do.). 3. ab. 5.40. 4. one series. 5. 3 secs. 6. pr. 4. 7. thunder.

2752. Do.—Mr. Joseph Lloyd * (Do.). 3. 5.40. 4. b. ab. 3 movements, each way, ab. $6\frac{1}{2}$ secs. c. yes. d. beg. and end of prin. vibra. well-marked, no appreciable interval bet. them and subsequent trembling. f. no. 6. 5. 7. a deep rapid so., rather like that of an object whirled rapidly in the air. b. f. prin. vibra. imm. c. f., appeared to outlast the subsequent trembling considerably, as if passing away to the S. or S.E. d. yes. e. c. f. no.

2753. Do.—Mr. and Miss * Watson (Do.). 3. bet. 5.35 and 5.40. 4. a. no. b. movement like that of a cradle. c. yes. d. began suddenly. 6. < 4. 7. a strong deep humming so., as of wind through trees. b. p.

2754. Do.—Mr. J. Jones (Do.). 3. ab. 5.30. 4. one series. d. yes. e. mid. 5. 7 secs. 6. chandeliers and pictures swung. 7. a carriage passing. b. f. a few secs. c. f. d. grad. died away.

2755. Do.—Mr. O. Harvey * (Do.). 3. 5.38. 4. a. yes. b. 5 vibra, 6 secs. e. beg., decr. grad. in int. 6. pr. 5. 7. no.

2756. Do.—Anon.* (Do.). 3. ab. 5.30. 4. one series. f. yes. 5. ab. 6 to 8 secs. 6. 5.

2757. Do.—Mr. G. Davies † (Do.). 4. the movement not trem., but from side to side several times. g. N. and S.

2758. Do.—Mr. R. Williams † (Do.). 6. < 4.

2759. Do.—Anon. (Do.). 4. g. S. to N.

2760. Do.—Anon. (Do.). 4. g. S.E. by E. and N.W. by W. 6. 5.

2761. Do.—Mrs. W. Thomas * (Do.). 4. a sudden rush, as if a train or great crowd had passed from W. to E.; the bed shaking with a severe lateral motion. 6. pr. 5. 7. a loud rumbling acc. the rush.

2762. *Carnarvon*.—Mr. S. Maurice Jones † (Do.). 3. ab. 5.35. 4. b. 2 or 3 vibra. c. yes. d. yes. e. beg. f. no. 5. pr. 5 secs. 6. 5. 7. something like the roaring of wind through an open chimney. b. f., an appreciable interval. c. f. d. yes. e. f.

2763. *Ceris Bangor*.—Mr. J. R. Davies * (Do.). 3. 5.30. 4. one sh. f. no. g. E. to W. 5. 1 sec. 6. < 4: an unlatched cupboard-door swung wide open to the E. 7. a deep boom, like a very distant and great explosion. b. c. c. c.

2764. *Conway*.—(*N. Wales Chronicle*, Bangor, Dec. 19.) 4. sh. felt.

2765. *Criccieth*.—Mr. G. J. Day. 3. 5.30. 4. one continuous trem. vibr. 5. ab. 3 secs. 7. an approaching train: the so. seemed to p. and f. the sh.

2766. *Deganwy*.—Mr. C. J. Wallace, J.P.† 3. 5.32. 4. the bed was shaken roughly from W. to E. 5. ab. 20 secs. 6. 6 (the house solidly built, with $2\frac{1}{2}$ feet stone walls, but the foundation entirely on sand); every wall running W. and E. had pictures displaced towards the E. ab. $1\frac{1}{2}$ ins.; all the top bedrooms had their ceilings more or less damaged; in one, pieces of whitening were scattered on the floor. 7. a rumbling so., wh. entirely p. the sh.

2767. *Llanbedrog*.—(c. by Mr. C. S. Dennis.) 6. 5. 7. no.

2768. *Llandudno*.—(c. by Mrs. C. le Neve Foster.) 3. ab. 5.30. 4. the bed appeared to be lifted up and down. 7. no.
2769. Do.—(*N. Wales Chronicle*, Bangor, Dec. 19.) 6. 5.
2770. *Llanfairfechan*.—Rev. P. C. Ellis.† 3. ab. 5.30. 6. 5. 7. no.
2771. *Morfa Nevin*.—C. M. Jones. 6. pr. 5. 7. no.
2772. *Nantlle Vale*.—Anon.* 3. 5.30 to 5.40. 4. one sudden sh. 5. 1 sec. 6. pr. 5.
2773. *Nevin*.—(c. by Mr. C. S. Dennis.) 6. 5. 7. no.
2774. *Penmaenmawr*.—Anon.* (c. by Mr. E. Greenly.) 3. 5.35. 4. a violent rocking of the bed. 6. 5; some things fell in the kitchen.
2775. *Portmadoc*.—Mr. E. Roberts* (c. by Mr. C. S. Dennis.) 3. 5.35. 5. $\frac{1}{2}$ sec.
2776. Do.—(*Daily Chronicle*, Dec. 18.) 6. 5. 7. a rumbling noise.
2777. *Pwllheli*.—Mr. J. S. Morgan* (c. by Mr. C. S. Dennis.) 3. 5.32. 4. a. yes, slight, 2 or 3 secs. b. ab. 1 sec. c. no. f. yes. 6. 5. 7. no.
2778. *St. Tudwall Lighthouse*.—Mr. E. J. Neale* (on ground floor of tower). 3. 5.25. 4. one series; beg. suddenly and grad. passed away. 5. 2 or 3 secs. 6. < 4. 7. a short and sudden so., such as would follow the blasting of a stone quarry. b. p. imm. c. p. ab. 3 secs. [so that end of so. and beg. of sh. must have c. nearly]. e. p. ab. 2 secs. f. no.
2779. *Tavimeibion*.—Mrs. Williams (c. by Mr. E. Greenly). 4. felt first distinct transverse vibra., and afterwards vibra. from E. to W.
2780. *Treborthuchaf*.—Mrs. Vincent† (Do.). 3. 5.40. 4. g. N. and S. 6. 5. 7. pr. yes, as the eq. was thought to be blasting at slate quarries.

MERIONETHSHIRE

2781. *Aberdovey*.—Mr. E. Jones (c. by Rev. J. Rowland). 3. 5.37 A.M. 4. 3 or 4 vibrs. d. yes. e. end. f. no. 5. 3 or 4 secs. 6. 5. 7. a train passing through a tunnel. b. c. c. c. d. became grad. louder. e. c. f. no.
2782. *Bala*.—Mr. G. Ward. 3. bet. 5.30 and 5.32. 4. 1 vibr. f. yes. 5. 1 sec. 6. 5. 7. the sh. p. by a so. as of a strong rush of air, but no rumble [the so. pr. p. the sh. entirely].
2783. *Barmouth*.—(*Barmouth and County Advertiser*, Dec. 24.) 3. shortly after 5. 6. pr. 5.
2784. *Blaenau Festiniog*.—Mr. W. R. Davies.† 3. 5.35. 4. e. mid. 6. 4. 7. the approach of a train; one continual rumble, strongest at mid.
2785. *Corris*.—(*Montgomeryshire Echo*, Llanidloes, Dec. 19.) 4. sh. distinctly felt.
2786. *Dôlwlwel*.—Mr. R. Roberts.* 3. ab. 5.31 or 5.32. 4. several vibrs. e. beg. f. no. 5. 6 to 8 secs. 6. 5. 7. a rumbling so.
2787. *Dolgelly*.—(c. by Mr. J. Hill.) 3. 5.33. 4. a. yes, 15 to 20 secs. b. ab. 6 or 8 secs. c. no. d. yes. e. end. f. yes. 6. 5. 7. as if stalled cattle had broken loose. b. p. c. p. imm. d. incr. grad. and died away suddenly. e. c.

2788. *Dyffryn*.—Mrs. Williams* (c. by Mr. E. Greenly). 3. ab. 5.40. 4. the bed shook 3 times from side to side. 5. > a few secs.

2789. Do.—Mr. A. A. Mitcherd† (c. by Mr. C. S. Dennis). 3. ab. 5.30. 4. the bed vibrated as if a goods-train were passing the station. 5. ab. 5 or 6 secs. 7. a heavy goods-train passing the station: at the same time as the sh.

2790. *Hengfort*.—Miss F. P. Cobbe.† 6. 4. 7. a loud so. like an explosion.

2791. *Llanderfel*.—Mr. C. E. Morgan.* 3. 5.35. 5. > 1 sec. 6. < 4. 7. a light clear musical so., wh. grew in int. until ab. the mid. and then died away. b. f., ab. 1 sec. c. f. 6 to 8 secs. d. yes. e. f. ab. 4 secs. (Most persons describe the so. as a low rumbling like a traction-engine passing.)

2792. Do.—(c. by Mr. T. Ruddy.) 6. 5.

2793. *Llanegryn*.—Rev. D. Hughes.* 4. the bed moved from one side to another, 3 or 4 vibra; no trem. mot. 5. ab. 4 or 5 secs. 6. 5. 7. no.

2794. *Llanfihangel Glyn Myfyr*.—Rev. W. J. Williams. 3. bet. 5.30 and 5.35. 4. ab. 2 or 3 vibra. e. mid. f. slight. 5. ab. 7 secs. 6. 5. 7. a threshing-machine. c. f.

2795. *Llanymawddwy*.—(c. by Mr. J. Jenkins.) 3. ab. 5. 4. a. yes, 1 sec. b. one vibr., > 1 or 2 secs. c. yes, ab. $\frac{1}{2}$ sec. d. only one max. f. yes. 5. ab. 2 secs. 6. < 4. 7. a luggage-train going over a bridge. b. p. ab. 1 sec. d. no; first the rumbling so. was heard and then instantly the sh.

2796. *Mynyfordd*.—Mr. W. Jones (c. by Mr. C. S. Dennis). 3. ab. 5.25. 4. one series. d. yes. e. mid. f. no. 5. ab. 2 secs. 7. rumbling so. with the sh. d. yes. e. c. f. no.

2797. *Palé*.—Mr. T. Ruddy. 3. 5.35. 4. a sudden and violent rocking, wh. grad. died away. f. yes. g. W. to E. 6. 5. 7. a heavy waggon passing. b. p. d. yes. e. the rocking seemed to occur when the so. was at its loudest.

2798. *Pennal*.—(*Montgomeryshire Echo*, Llanidloes, Dec. 19.) 4. sh. distinctly felt.

2799. *Pensarn*.—Mr. T. Ninish (c. by Mr. C. S. Dennis). 3. 5.27. 4. 3 even vibra. f. no. g. S. to N. 5. 2 secs. 6. 5. 7. no.

2800. *Rhiig*.—Mr. J. Bennett.* 3. 5.30. 4. a. yes, ab. 6 secs. b. one [series?]. c. no. d. yes. e. mid. f. yes. 6. 5. 7. a rush of wind. b. p. ab. 6 secs. d. yes.

CARDIGANSHIRE

2801. *Aberayron*.—E. Lloyd.† 3. 5.30 A.M. 4. at least 3 vibra. f. yes. g. E. to W. 5. 3 or 4 secs. 6. pr. 5; a large cover hanging in the kitchen was tilted some inches towards the W.; a lamp was thrown down in one house.

2802. Do.—(*Western Mail*, Cardiff, Dec. 18.) 3. ab. 5.30. 6. 4.

2803. *Aberystwith*.—Dr. T. P. Beddoes.† 3. 5.30. 4. 2 series. e. end. f. no. 6. 5. 7. a buzzing noise for a few secs. b. p.

2804. Do.—Mr. J. Kilvington † (c. by Mr. C. S. Dennis). 3. 5.35. 4. 2 sharp motions of the bed from side to side. c. yes, ab. 3 secs. 6. pr. 5; plaster fell from the ceiling. 7. a distant train.

2805. Do.—(*Montgomery County Times*, Welshpool, Dec. 19.) 6. 5: a clock was thrown from the wall in one house.

2806. Borth.—Mr. H. Stinchcombe.* 3. 5.30 or 5.31. 5. ab. 10 secs. 6. 5? 7. another obs. thought a train was passing.

2807. Bow Street.—Mr. L. Rees. 3. ab. 5.30. 5. ab. 2 secs. 6. < 4.

2808. Cardigan.—(*Cardigan Observer*, Dec. 19.) 3. 5.30. 4. g. W. to E. 5. 4 or 5 secs. 6. 5? 7. the sh. acc. by a rumbling noise.

2809. Cefn-Mabwa.—(c. by Rev. D. Jenkins) 5. several secs. 7. an indistinct rumbling noise.

2810. Cilcennin.—Rev. T. Jones† 3. ab. 5.30. 4. a violent shaking of the bed.

2811. Glandovey.—Mr. J. Davies (c. by Mr. C. S. Dennis). 3. 5.30. 4. one series. f. no. 5. ab. 2 or 3 secs. 6. pr. 3. 7. a heavy clap of thunder at a distance. d. yes.

2812. Llandewi Brefi.—Rev. T. R. Davies. 3. ab. 5.30. 4. d. yes. 5. ab. 2 secs. 6. 5; some ornaments were thrown down from a mantelpiece in the village. 7. a cart or steam-roller going along the road.

2813. Llanfihangel-y-Creuddyn.—Rev. J. P. Evans.* 3. 5.45. 4. one series, almost uniform but, if anything, stronger in the mid. 5. ab. 15 secs. 6. < 4. 7. distant thunder, the end of the so. c. with the beg. of the sh.

2814. Llanfihangel Crucorney.—Anon.† 3. 5.35. 4. as if an animal shook itself under the bed. f. yes. 5. 30 secs. 6. 5?

2815. Llangeitho.—(c. by Rev. D. Worthington.) 4. sh. felt very much in some houses.

2816. Llangwryfon.—(c. by Rev. D. Jenkins) 4. the bed shook. 6. imm. after the sh., a lot of rubbish came down the chimney. 7. a gust of wind.

2817. Llanilar.—Rev. J. T. Griffiths. 3. bet. 5.30 and 6. 6. 4.

2818. Penbryn Bach.—(c. by Rev. D. Jenkins.) 6. pr. 5. 7. a rumbling noise.

2819. Penlona.—Anon.* (Do.). 6. 5. 7. a rumbling noise.

2820. Strata Florida.—Rev. E. Jones. 3. ab. 5.30. 4. only a slight sh. 5. ab. 3 or 4 secs. 6. pr. 5.

2821. Tregaron.—Mr. T. Jones† 3. ab. 5.35. 4. the house shook as if a train had passed beneath. 5. 5 secs. 6. 5. 7. the rush of distant wind. b. pr. c. d. yes. e. pr. c.

2822. Tynybedw.—Rev. W. J. Williams† 3. ab. 5.45. 4. no vibra. felt. 7. a loud rumbling noise.

2823. Ystrad Meurig.—Rev. J. Jones. 3. ab. 5.45. 4. only one sh. 5. ab. 1 sec. 6. pr. 5. 7. as if snow had fallen from the roof of the house with a thud to the ground.

PEMBROKESHIRE

2824. *Bosheston*.—Rev. J. Grey Lloyd.† 3. 5.30 A.M. 6. 4.
 2825. *Haverfordwest*.—(*Western Mail*, Cardiff, Dec. 19.) 4. the sh. felt by a few persons.
 2826. *Pembroke Dock*.—Mr. D. Jenkins.* 3. 5.34. 4. 2 series, the first stronger and lasting ab. 6 secs.; interval 2 secs.; the second lasting ab. 4 secs.; ab. 3 vibrs. a sec. g. N.W. and S.E. 6. 5? 7. distant rumbling, only noticed during and after the sh., lasting 10 secs. or more.
 2827. Do.—(*S. Wales Daily News*, Cardiff, Dec. 18.) 3. ab. 5.30. 5. ab. a min. 6. 4. 7. the sh. acc. by a rumbling so. like that of heavy waggons.
 2828. *St. Davids*.—(c. by Dr. W. P. Probert, F.G.S.) 4. sh. felt by many persons.
 2829. *St. Dogmaels*.—Miss L. Bradley.* 3. ab. 5.30. 4. certainly 2 shs., possibly 3; a sensation as of a hammer striking the bed midway on one side, simultaneously with wh., or nearly so, there was a gentle shaking of the bed. 5. < 1 min. 6. < 4. 7. a so. heard, neither rumbling nor dull, such as might be made by the fall of a few walking-sticks; there was a rattling so. with the first sh.
 2830. *Tenby*.—(*S. Wales Daily News*, Cardiff, Dec. 18.) 3. ab. 5. 4. sh. felt by several persons.
 2831. *Trewanen*.—Mr. H. W. Davis† 6. 4.
 2832. *Upton Castle*.—Anon. 3. 5.45. 4. only one sh. 5. ab. 30 secs. 6. 5.

CARMARTHENSHIRE

2833. *Ammanford*.—Mr. R. Callard † (*Western Mail*, Cardiff, Dec. 19). 3. 5.35. 4. 2 series, with an interval of a few secs. bet. 6. 4. 7. a rumbling so. acc. the sh.
 2834. *Burry Port*.—Anon.* (c. by Mr. J. G. Thomas, F.G.S.). 3. ab. 5.30. 4. a continuous trem. mot. f. no. 5. ab. 2 secs. 6. < 4. 7. a slight explosion, almost like a gun-shot, f. imm. by trem. mot.
 2835. Do.—Mrs. Gowen* (Do.). 3. ab. 5.30. 4. ab. 4 vibrs. 7. a train shunting.
 2836. *Carmarthen*.—Mr. A. C. Evans* (*Welshman*, Carmarthen, Dec. 18). 3. 5.38. 4. 2 series, 13 vibrs. in the first 8 secs., then a momentary pause [3 secs.], after wh. there were ab. 8 or 9 vibrs. in the next 4 secs. 5. 15 secs. 6. 4. 7. no.
 2837. Do.—Mr. J. John † (*S. Wales Daily News*, Cardiff, Dec. 18). 4. f. yes. 6. 5.
 2838. *Cilycwm*.—O. Evans† 4. a slight rocking of the bed. 6. 5? 7. no.
 2839. *Conwil Caio*.—Rev. C. Chidlow.* 3. ab. 5.30. 4. a heaving, rolling movement. d. yes. e. mid. 5. ab. 10 secs. 6. 5. 7. an approaching whirlwind. b. p. 4 or 5 secs. c. f. 4 or 5 secs.

2840. *Dôlygarreg*.—Mrs. Bishop.† 3. 5.25. 4. a vigorous shaking or trembling (not rocking) of the bed. 5. ab. 10 secs.
2841. *Glanammon*.—Mr. M. Lewis. 3. 5.41. 4. trem. mot. 5. 5 secs. 6. 5. 7. no.
2842. *Kidwelly*.—(Standard, Dec. 18.) 6. 4.
2843. *Laugharne*.—Rev. J. Thomas.* 3. ab. 5. 4. f. no. 5. ab. 1 sec. 6. 5? 7. a carriage passing.
2844. *Llandilo*.—(c. by Rev. L. Price.) 4. sh. felt. 7. a rumbling so.
2845. *Llandovery*.—Anon.* (c. by Mr. J. Watkins). 3. 5.40. 4. a. yes. b. 2 shs., the first stronger and closely f. by the second. g. N. to S. 6. 5. 7. heavily loaded carts passing. b. p.
2846. *Llanelly*.—Mr. J. F. Young.* 3. 5.31. 4. 2 shs., ab. 8 to 10 secs. apart, the first stronger. g. S.W. to N.E. 5. the shs. ab. 8 to 10 secs. each. 6. 5. 7. a deep booming so. at first, ending with a fizzing so. like that wh. follows a flash of lightning when near the earth; the boom acc. the sh., the fizzing so. ended imm. the sh. ceased.
2847. *Do*.—Mr. J. Havard.† 3. ab. 5.30. 4. trem. mot. 6. 4.
2848. *Llanfihangel Rhos Corn*.—Rev. H. Hughes.† 4. sh. felt. 7. like snow sliding off the roof, but louder.
2849. *Llangadock*.—(c. by Rev. W. Rees.) 4. sh. felt.
2850. *Llanpumpaint*.—Rev. J. Lloyd. 3. ab. 5.30. 4. a trem., not a wave-like, motion. 6. 4.
2851. *Nantgaredig*.—Dr. S. G. Morris. 3. ab. 5.30. 4. 2 distinct parts, separated by 2 or 3 secs. f. yes. 5. a few secs. 6. 5.
2852. *Newcastle Emlyn*.—Rev. W. Powell. 3. 5.30. 4. f. yes. 5. only a few secs. 6. pr. 5. 7. a rumbling so. pr. 2 secs.; the end of the so. c. with the beg. of the sh.
2853. *Penboyr*.—Anon.† (c. by Rev. T. Jones). 3. ab. 2.45 [*sic*]. 4. a very slight sh. 6. a very few secs.
2854. *Pontardulais*.—(Western Mail, Cardiff, Dec. 18.) 6. 5?
2855. *St. Clears*.—(c. by Mr. S. Cooper.) 4. sh. felt.
2856. *Whitland*.—Mr. W. Lewis.* 3. 5.33½.* 4. a. yes, ab. 2 secs. b. ab. 3 secs. c. yes, ab. 2 secs. d. yes, only one max. e. mid. f. slight. g. S.W. and N.E. 5. 6 to 7 secs. 6. pr. 5; two lamps attached to the roof of the signal-box swung considerably. 7. distant thunder. b. c. c. c. e. c.

ISLE OF MAN

2857. *Ballasalla*.—(c. by Rev. S. N. Harrison.) 4. sh. felt.
2858. *Ballaugh*.—(Do.) 4. a tremor. 7. a rolling so. from the S. at ab. the same time as the sh. (according to another obs., like a thud against the house at the same time as the sh.).
2859. *Derby Haven*.—(Do.) 3. 5.30 A.M. 4. the vibr. like that of a steamer when rising out of a trough of the sea. 7. no.
2860. *Douglas*.—Mr. P. Kelly.† 3. ab. 5 or 6. 4. 2 series, the first stronger. g. E. and W. 6. 4.
2861. *Maughold*.—(c. by Rev. S. N. Harrison.) 4. a tremor.

2862. *Peel*.—(Do.) 4. a tremor.

2863. *Point of Ayre Lighthouse*.—(Do.) 6. shaking of the light in the lighthouse. 7. a so. in the N.W. p. the shaking.

2864. *Port Erin*.—(c. by Mr. S. Clarke.) 4. sh. felt by two persons in different houses.

2865. Do.—(c. by Rev. S. N. Harrison.) 3. 5.20. 4. a rocking sensation.

2866. *Ramsey*.—Rev. S. N. Harrison. 3. 5.35. 4. 3 vibra. [series?]. 5. ab. 30 secs. 6. 4. 7. imm. the sh. ceased, there was a so. at first more like one or two strong blasts of wind in separate puffs, passing into a rumbling so.; the so. lasted a min. or more, and seemed to pass from S.E. to N.W.

2867. *Rushen*.—(c. by Rev. S. N. Harrison.) 4. a rocking motion. 7. no.

CO. DUBLIN

2868. *Dublin*.—Mr. W. Carey * (c. by Prof. G. A. J. Cole, F.G.S.). 3. ab. 5 A.M. (Dublin time). 4. a sudden vibr. g. S.E. to N.W. 5. a few secs. 7. no.

2869. Do.—Mr. H. J. S. Fullerton (Do.). 3. bet. 5 and 5.30. 4. the bed trembled and the furniture in the room creaked.

2870. *Monkstown*.—Mr. H. R. Perry (Do.). 3. ab. 5.20. 4. sh. felt distinctly.

2871. *Terenure*.—Anon.† 4. a slight shaking of the bed. g. E. and W. 5. ab. 5 secs.

CO. WICKLOW

2872. *Baltinglass*.—(c. by Mr. J. G. R. Powell) 3. ab. 5.36 A.M. 6. 4.

2873. Do.—(*Daily Express*, Dublin, Dec. 18.) 3. ab. 5.15. 4. a quivering, f. by a sinking of the bed and rising again, as if a wave were passing from N. to S. 5. ab. 4 secs. 6. pr. 4. 7. a rumbling noise. b. p.

2874. *Bray*.—(c. by Mr. E. H. Fairbrother.) 3. 5.15. 5. $\frac{1}{4}$ min. 6. 4.

2875. Do.—Mr. H. H. Head (*Daily Express*, Dublin, Dec. 19). 3. 5.16 \pm 2 mins. 4. a decided rocking from N. to S.

2876. *Fassaroe*.—Miss L. Gyles † (c. by Mr. R. M. Barrington). 3. pr. ab. 5.20. 5. several secs.

2877. Do.—Miss A. Barrington * (Do.). 3. pr. ab. 5.20. 4. 2 or 3 slight vibra, without any change of int. f. no. 5. ab. 10 secs. 7. a violent gust of wind in the chimney; the so. f. imm. after the sh. d. yes.

2878. *Glenealy*.—Mrs. De Beetes. 3. 4.45. 4. 2 series, the first stronger, the second lasting a longer time, separated by an instant or so. 7. no.

2879. *Greystones*.—(c. by Mr. J. G. R. Powell) 6. 4.

2880. Do.—(*Daily Express*, Dublin, Dec. 18.) 3. ab. 5. 4. sh. distinctly felt.

2881. *Killarney Hill*.—Anon.† (*Irish Times*, Dublin, Dec. 19.) 3. bet. 5 and 5.30. 6. 4.

2882. *Knockdolian*.—(*Daily Express*, Dublin, Dec. 18.) 6. pr. 4.

2883. *Newtownmountkennedy*.—Mr. E. Barry (*Irish Times*, Dublin, Dec. 19.) 3. 5.15. 4. a slight vibr. g. E. to W. 5. ab. 5 secs. 7. a rumbling so.

2884. *Oatlands* (near Wicklow).—Miss J. M. Shepard. 3. ab. 5.20. 4. a tremor. 6. 4. 7. one obs. thought she heard a dull rumbling so, not very loud, before the sh. was felt.

2885. *Powerscourt*.—The Ven. Archdeacon H. Galbraith † (c. by Prof. G. A. J. Cole). 3. ab. 5. 4. the bed shaken from side to side. g. E.S.E. to W.N.W.

2886. *Sandymount*.—(*Irish Times*, Dublin, Dec. 19.) 3. 5.15. 5. ab. 5 secs. 7. a noise similar to what is made in the effort to raise a stiff window.

CO. WEXFORD

2887. *Camolin*.—J. O'Kane. 3. ab. 5 A.M. 4. as if a traction-engine were passing the house. 5. ab. 6 or 7 secs. 7. no.

2888. *Castlebridge*.—Rev. T. O'Connor (c. by Prof. G. A. J. Cole). 3. ab. 4.45. 4. the bed shook. 5. a few secs.

2889. *Killinick*.—Rev. J. T. Newbury (Do.). 3. ab. 5. 4. only one sh.; the house shook as if a traction-engine were passing. 5. ab. 4 or 5 secs. 6. 4. 7. no.

2890. *Wexford*.—Mrs. Wheelock. 3. bet. 5 and 6. 6. 4. 7. rumbling noise. b. p.

CO. ANTRIM

2891. *Belfast*.—Mr. W. Workman. 3. bet. 4 and 5 A.M. 4. a tremor. 5. 1 or 2 secs. 6. 3. 7. no.

CO. CAVAN

2892. *Killeshandra*.—Rev. H. F. Martin * (c. by Prof. G. A. J. Cole). 3. 5.7 A.M. Heard a noise as if some one were shaking the handle of a side-door under the window, lasting 4 or 5 secs.

CO. MEATH

2893. *Drumcondra*.—Mr. S. I. Morgan (c. by Prof. G. A. J. Cole). 4. only one sh. 6. 4?

CO. KILKENNY

2894. *Graigie*.—Mr. R. A. Bennett (c. by Prof. G. A. J. Cole). 3. ab. 5.20. 4. a slight shake of the house, as if a cart had passed close by. 6. 4?

CO. CLARE

At Milltown Malbay, Mrs. Mordey, who was awake at the time, heard a loud; groaning, rumbling or rolling noise at 5.5 or 5.6 A.M., that appeared to pass from the N.W. and die away towards the east; her coachman's wife also heard the noise. On account of the isolated position of the place of observation and its great distance from the epicentre, I think it is difficult to connect this noise with the Hereford earthquake, though it is equally difficult to suggest any adequate cause for it.

ADDENDA

2895. *Birmingham*.—Mr. A. E. Buckley,* 21 Lime Grove, Lozells. 3. 5.34 A.M. 4. as if a strong man had grasped the bed and shaken it backwards and forwards 3 or 4 times, very slightly lifting the foot at the same time. 5. ab. 3 secs. 6. 5.

2896. Do.—“P.” (*Daily Argus*, Birmingham, Dec. 17), Lozells Street. 3. ab. 5.30. 6. 6?

2897. Do.—Mr. W. Allen (c. by Mr. W. J. Harrison, jun.), Brougham Street. 3. 5.40. 4. one tremor, lateral uplift to W. 6. 5. 7. a buzzing so. previous to tremor.

2898. *Cliff House* (Warwickshire, near Tamworth).—Mr. J. Norman. 3. 5.29. 4. swaying movement from N.E. to S.W., p. and f. by trem. mot. 5. 3 to 4 secs. 6. pr. 6. 7. distant thunder. b. f. imm.

2899. *Langley* (Worcestershire, near Birmingham).—Mr. A. Trowbridge.* 3. 5.34. 4. the vibra. similar to those produced when a traction-engine with large boilers passes within 50 yds. of the house, only one sh. f. no. 5. ab. 2 secs.

2900. *Uppingham* (Rutland).—Rev. G. H. Mullins.* 3. 5.35. 4. 2 series, each lasting ab. 2 secs., separated by an interval of 10 or 15 secs. 7. a waggon with luggage passing.

2901. *Rathgar* (Co. Dublin).—Mr. F. P. Fawcett (*Daily Express*, Dublin, Dec. 19). 3. ab. 5.15 (Dublin time). 6. pr. 4. 7. the sh. was acc. by a rumbling noise.

2902. *Straffan* (Co. Kildare).—“E. B.” † (*Irish Times*, Dublin, Dec. 19). 3. 5.10. 4. 2 distinct shs. g. ab. E. to W. (as shown by the water in a glase). 6. 4.

CHAPTER III

RECORD OF OBSERVATIONS : MINOR SHOCKS

THE study of the minor shocks is rendered very difficult from the facts that all of them were slight and that many occurred in the middle of the night and before the attention of observers was aroused. A weak tremulous motion with or without accompanying sound, or a slight rumbling noise like distant thunder without any shock, seems to have been the common experience, but it is doubtful whether more than a very few observers were so convinced as to its true nature as to note the time with any approach to accuracy. A report like the following, for instance, is by no means of rare occurrence. "I felt another shock earlier in the morning or night. I am sorry I cannot tell what time it was ; it might have been any time between 10.30 P.M. and 5.0 A.M., but my impression is that there was a considerable interval" between it and the principal shock. Even when the times are given approximately, it is often not at all easy to identify the shocks felt at different places. The following records are therefore given in chronological order. When several are grouped together under one heading, it may be regarded as nearly or quite certain that some, but not necessarily all, of them refer to a true earthquake, which occurred about the time mentioned.¹ With regard to the intermediate records, the evidence is less decisive. It is possible, on the one hand, that they imply the occurrence of independent shocks, and, on the other, that, if the times had been more accurately given, they would have been classed with those which preceded or followed it. Or, again, the disturbance mentioned may not have been of seismic origin at all ; and, when we remember how closely some spurious earthquakes simulate the true phenomenon, we shall be fully prepared to make a large allowance under this heading, especially after the occurrence of the principal earthquake.

The first six records refer to some disturbances observed before the first undoubted shock on Dec. 16.

¹ When the name of the place of observation is not printed in italics, the record is in my opinion, of doubtful connexion with the earthquake under consideration.

1. Dec. 12 : Pontrilas Court (H.).¹—Mrs. Attwood-Mathews. Two detonating sounds, apparently underground, were heard.

2. Dec. 13, ab. 4.15 P.M. : Westwood Hall (St.).—Mr. J. Robinson.* A noise, as of a heavy roll of carpet falling from a high table on a bare floor ; this caused the ceiling and walls to vibrate very sensibly, but only momentarily.

3. Dec. 14, ab. 4.30 A.M. : Maeswllch Castle (R.).—Mr. A. Grimbles.* A very heavy burst of wind seemed to strike the Castle ; the next second, the bed oscillated five or six times rapidly, and the green baize door of the room (a swing door) opened and shut a similar number of times with some violence, and the jugs and basins rattled.

4. Dec. 15, ab. 5 P.M. : Charlton Kings (Gc.).—(c. by Mr. S. S. Buckman, F.G.S.). A little boy playing on the floor said that it seemed to be moving.

5. Dec. 15, 9.10 P.M. : Further Barton (Gc.).—Miss J. E. A. Brown.* A sudden rattling of the window-pane precisely similar to that which occurred during the principal eq., but no sh. was felt.

6. Presteign (R.).—Mr. F. Bromley. Several slight shocks are believed to have occurred for a fortnight before the principal eq., but all were felt during the night and received but little attention.

A. DEC. 16, ABOUT 11.0 OR 11.30 P.M.

7. Clifton (Gc.).—(c. by Mr. G. Simpson.) 3. ab. 11 P.M. 4. a slight sh. felt.

8. Hasfield (Gc.).—(c. by Mr. H. Wintle, F.R.G.S.) A mild sh. felt ab. midnight.

9. Stancombe Park (Gc.).—Mrs. Edwards. 3. 10.30. A trem. mot. and slight noise ; duration 2 secs.

10. Uley (Gc.).—Miss A. M. Brown.* 3. bet. 10 and 11. A so., as of stones falling, for a few secs.

11. Great Malvern (Wc.).—Anon.* (c. by Mr. J. G. R. Powell). 3. ab. 11. A noise heard.

12. Rock (Wc.).—(c. by Rev. F. A. Reiss.) 3. 11.30. A very slight vibr., wh. caused the glasses on the candlesticks to jingle.

13. Selly Park (Wc.).—Anon. 3. bet. 11.15 and 11.30. A slight rocking of a pair of rather loose window-shutters facing the S., acc. by a slight vibr. of the ground.

14. Court of Hill (Sh.).—Mr. A. Hill-Lowe. 3. ab. 10.45. An extraordinary noise like rushing wind, but the air outside was perfectly still.

15. Smethcote (Sh.).—Mr. W. R. Blackett* (c. by Mr. E. S. Cobbold). A somewhat faint rattling of the window, of the same character as that wh. occurred during the principal eq.

16. Charlbury (Ox.).—(*Banbury Guardian*, Dec. 24.) 3. soon after 11. A sh. felt.

17. Birmingham (W.).—Mr. S. R. Davis. 3. ab. 11.30 to 11.45. A slight vibr. and a peculiar rumbling so.

18. Do.—(c. by Rev. F. A. Reiss.) 3. 11.30. A slight vibr. felt.

¹ The list of abbreviations for the names of the counties is given on p. 9.

19. *Handsworth* (St.).—Mr. J. Spencer.* 3. ab. 11. "I was . . . having a game of billiards . . . and had been using a long cue and rod and carefully placed them after using so that they slightly inclined towards the corner of the stand, but much to my surprise they both crashed down with tremendous force."

20. *Walsall* (St.).—A. Hopley. 3. ab. 11. A very slight, but very distinct, sh.

21. *Milnrow* (L.).—Mrs. J. B. Petrie* (c. by Prof. J. Milne, F.R.S.). 3. some time after 10. A very slight tremor.

22. *Brixton, S.W.* (Sr.).—Mr. C. E. Vincent* (c. by Prof. J. Milne, F.R.S.). 3. ab. 11. 4. A pulsating or vibrating feeling, like that of a very mild electric current; an ornament on the table, wh. generally vibrates with any shaking in the room, moved slightly; the window creaked once. 5. ab. 10 *seca*.

23. Dec. 17, bet. 12 and 1 A.M.: *Suckley* (Wc.).—(c. by Miss M. G. Kane.) One of the servants heard the doors banging; no one was about at the time.

24. Dec. 17, ab. 12.30 A.M.: *Burton-on-Trent* (St.).—(c. by Mr. F. E. Lott.) Mr. C. O'Sullivan, F.R.S., reports having noticed tremors for some time, quoting one ab. 12.30 the same night.

B. DEC. 17, ABOUT 1 A.M.

25. *Stancombe Park* (Gc.).—Mrs. Edwards. 3. 1 A.M. 4. trem. mot. and slight noise, like shaking doors, three times at intervals of two minutes.

26. *Tetbury* (Gc.).—(*Stroud News*, Dec. 18.) 3. 1. 4. sh. felt.

27. *Birmingham* (W.).—Mrs. A. Harris. 3. ab. 1. 7. two loud reports were heard, for wh. we could not account.

28. *Leamington* (W.).—Nurse F. M. Bayley.* 3. ab. 1. 7. a rather peculiar noise heard.

C. DEC. 17, ABOUT 1.30 OR 1.45 A.M.

29. *Cleghonger* (H.).—Anon.† (c. by Rev. E. J. Holloway). 3. 1.45 A.M. 7. obs. awakened by the so. as of some one banging against the doors.

30. *Defford* (Wc.).—Rev. G. Swinden. 3. ab. 1.30. 4. a slight sh.

31. *Great Comberton* (Wc.).—Rev. R. Shelmerdine.* 3. ab. 1.30. 4. a slight trem. mot. 7. acc. by a rushing so. like wind.

32. *Stokesay* (Sh.).—(c. by Rev. J. D. La Touche.) Some people report having experienced a slight sh. bet. 1 and 2.

33. *Bangor* (Cn.).—Mr. W. Dawson (c. by Prof. J. Milne, F.R.S.). 3. 1.42. 4. a distinct sh., wh. shook the bedroom window, as if by a gust of wind, but the night was quite calm.

D. DEC. 17, ABOUT 2 A.M.

34. *Lugwardine Court* (H.).—Anon.* (c. by Mr. H. Cecil Moore). 3. 2 A.M. 4. a slight sh.
35. *Evesham* (Wc.).—(*Times*, Dec. 18.) 3. ab. 2.10. 4. sh. felt.
36. *Feckenham* (Wc.).—Anon. (c. by Mr. W. C. Gould). 3. 2. 4. the bed shaken.
37. *Worcester* (Wc.).—Miss M. E. Webster.† 3. ab. 2.5. A clashing so., as if the fire-irons had fallen quickly or had been clashed together.
38. *Chetwynd Park* (Sh.).—(c. by Mrs. Borough.) 3. 1.50. 4. a slight sh. wh. made the jugs and basins rattle.
39. *Hopesay* (Sh.).—(c. by J. E. C. Barker.) 3. ab. 2. 6. 4. 7. a sudden gust of wind dying away at once.
40. *Hendre, The* (M.).—(c. by Rev. J. T. Harding.) 3. ab. 2.15. 4. a slight sh.
41. *Michael Troy* (M.).—Anon. (c. by Rev. H. M. T. Bickwell). 3. 2. 7. a noise as of a person falling downstairs.
42. *Monmouth* (M.).—(*Monmouthshire Beacon*, Monmouth, Dec. 18.) 3. 2. 4. a sh. is reported to have been felt.
43. *Birmingham* (W.).—Anon.* (c. by Mr. S. E. Cox). 3. towards 2. 4. the house shook. 7. a rumbling noise heard.
44. *Plas Llanfair* (A.).—(c. by Mr. A. Clegg.) 3. ab. 2. 4. one of the servants thought she felt a slight sh.

45. Dec. 17, ab. 2.30 A.M. : *Hindlip* (Wc.).—(c. by Rev. F. W. Wallis.) It is reported that a slight sh. was felt.

46. Dec. 17, 2.30 A.M. : *Kington, near* (Wc.).—(c. by Rev. W. J. Holden.) The attendants of a sick person noticed the doors rattling.

47. Dec. 17, ab. 2.30 A.M. : *Llangattock vibon avel*.—(c. by Miss M. J. E. Maclaverty.) Some people thought that there might have been a slight sh.

E. DEC. 17, ABOUT 3 A.M.

48. *Bromyard* (H.).—Mr. F. Philpott. 3. 3 A.M. 4. the bed shaken. 6. the obs.'s vest and watch fell. 7. no so. heard.
49. *Monnington-on-Wye* (H.).—Rev. M. Marshall† 3. ab. 3. 4. awakened by the sh.
50. *Avening* (Gc.).—Anon.† (c. by Rev. F. de Paravicini). 3. 3. 4. a slight sh. 7. so. heard.
51. *Compton Greenfield* (Gc.).—(c. by Rev. F. Brownson.) 3. ab. 3. 4. sh. felt.
52. *France Lynch* (Gc.).—Anon. 3. soon after 3. 4. a distinct shake.
53. *Newnham-on-Severn* (Gc.).—Mr. J. S. Carleton. 3. 3. 4. a slight vibr.
54. *Staverton* (Gc.).—(*Gloucestershire Echo*, Cheltenham, Dec. 17.) 3. ab. 3. 4. sh. felt.

55. *Tewkesbury* (Gc.).—(Do.) 3. ab. 3. 4. a slight oscillation.
56. *Thornbury* (Gc.).—(c. by Mr. J. S. Palmer.) 3. ab. 3. 4. a sh. felt, but not generally noticed.
57. *Clifton-on-Teme* (Wc.).—(*Worcester Herald*, Dec. 19.) 3. ab. 3. 4. a slight sh.
58. *Mainstone* (Sh.).—Anon.† (c. by Rev. W. E. Glenn.) 3. ab. 3. The obs. was aroused by what she thought was a waggon passing.
59. *Much Wenlock* (Sh.).—(c. by Rev. F. R. Ellis.) 3. 3.20. 4. a slight sh.
60. Do.—(*Times*, Dec. 18.) 3. 3.15. 4. a very slight sh.
61. *Woolstaston* (Sh.).—(c. by Rev. E. D. Carr.) 3. ab. 3. 4. a slight sh., not generally noticed.
62. *Yeaton Peverary* (Sh.).—(c. by Mrs. T. Auden.) 3. ab. 3. 4. a slight sh. 7. a slight noise.
63. *Presteign* (R.).—(c. by Mr. H. Jenkins.) 3. ab. 3. 4. a slight vibratory sh. felt.
64. *Monmouth* (M.).—(c. by Mr. E. H. Culley.) 3. ab. 3. 4. a slight sh. felt.
65. *Shirenewton* (M.).—(c. by Mr. E. J. Lowe, F.R.S.) 3. 3. 4. sh. felt.
66. *Castle Cary* (S.).—(*Bristol Observer*, Dec. 19.) 3. ab. 3. 4. sh. felt.
67. *Woolley* (Bk.).—Mr. G. Dunn † (c. by Prof. J. Milne, F.R.S.) 3. ab. 2.55. 4. no sh. felt. 7. a slight noise, lasting perhaps one sec., as though a chair or table had been pushed along the floor in the room below.
68. *Charlbury* (Ox.).—(*Banbury Guardian*, Dec. 24.) 3. 2.45. 4. sh. felt.
69. *Birmingham* (W.).—Miss Towers 3. 2.55. 4. sh. felt.
70. *Temple Balsall* (W.).—(c. by Mrs. Stewart.) 3. ab. 3. 4. a slight rocking motion. 7. a noise like that made by horses in stables.
71. *Liverpool* (L.).—Anon.† (c. by Rev. T. W. M. Lund.) 3. 3. 4. obs. awakened by a sh. acc. by thunder and lightning.
72. *Walton* (L.).—Mr. J. Williams 3. 3. A rumbling so. like thunder heard, but no lightning seen.
73. *Ewloe* (F.).—Mrs. J. Fox † (c. by Mr. J. Lomas.) 3. ab. 3. Awakened by a slight noise such as the furniture cracking.
74. *Weymouth* (Do.).—(*Daily Chronicle*, Dec. 18.) 3. 3. 4. sh. felt.

F. DEC. 17, ABOUT 3.30 A.M.

75. *Barnt Green* (Wc.).—Mrs. Moore Bayley.† 3. ab. 3.30 A.M. 4. a slight vibr. 5. ab. 5 secs. 7. a faint distant rumbling.
76. *Defford* (Wc.).—(Rev. G. Swinden.) 3. ab. 3.30. 4. a slight sh.
77. *Eckington* (Wc.).—(Mr. A. W. Allard.) 3. bet. 3 and 4. 4. a vibr. felt.
78. *Stanbrook* (Wc.).—Anon.† (c. by Rev. Canon E. Hilary Willson.) 3. ab. 3.30. 7. awakened by a distant rumbling, something like a train passing.

79. *Worcester* (Wc.).—(Mr. J. Lloyd Bozward, *Nature*, vol. 55, 1896, p. 178.) 3. 3.35. 4. a feeble sh. of short duration noticed by a few persons.
80. *Grimshill* (Sh.).—Mr. E. Elsmere.† 3. ab. 3.30. 4. an almost imperceptible tremor. 7. a slight noise.
81. *Newport*, near (M.).—(*S. Wales Times*, Newport, Dec. 18.) 3. ab. 3.30. 4. sh. felt.
82. *Bath* (S.).—(c. by Miss M. L. Jacques.) 3. 3.30. 4. a slight sh.
83. *Blundellsands* (L.).—Anon. 3. 3.25. 4. a shaking of windows and the bed as if by a strong gust of wind. 7. a rushing so. like a gust of wind: the night being particularly still.
84. *Aberdovey* (Me.).—Mr. E. Jones (c. by Rev. J. Rowland). Slight shs. were felt bet. 3 and 4.

G. DEC. 17, ABOUT 4 A.M.

85. *Bristol* (Gc.).—(*Daily Telegraph*, Dec. 18.) 3. ab. 4 A.M. 4. a very slight tremor.
86. *Droitwich* (Wc.).—(*Birmingham Daily Post*, Dec. 18.) 3. ab. 4.20. 4. a slight sh.
87. *Great Malvern* (Wc.).—Mr. J. G. R. Powell.† 3. ab. 3.50. 7. awakened by the so. of a sharp blow as if some one had struck the door with the hand.
88. Do.—Anon.† (c. by Mr. J. G. R. Powell). 3. ab. 3.50. 4. the bed shook transversely, E. and W. 7. obs. awakened by a rumble wh. seemed to come from the S., and then the bed shook.
89. Do.—(*Daily Chronicle*, Dec. 18.) 3. 3.50. 4. a sh. felt.
90. *Kidderminster* (Wc.).—Mr. A. Williams.† 3. towards 4. 4. a vibr. felt.
91. *Stourbridge* (Wc.).—(*Birmingham Daily Post*, Dec. 18.) 3. ab. 4. 4. a very slight tremor.
92. *Hopesay* (Sh.).—(c. by J. E. C. Barker.) 3. ab. 4. 6. 4. 7. a sudden gust of wind.
93. *Wolverhampton* (St.).—(*Daily Chronicle*, Dec. 18.) 3. 4. 4. a slight sh., noticed only by a few.
94. *Axminster* (D.).—Mrs. A. P. Rogers.† 3. 3.45. 4. bed shaken slightly. 5. > 10 secs.

95. Dec. 17, ab. 4.30 A.M.: *Tintern Abbey* (M.).—(c. by Mr. W. T. O. Jones.) A sh. felt.

96. Dec. 17, ab. 4.30 A.M.: *Burton-on-Trent* (St.).—(c. by Mr. F. E. Lott.) A sh. felt.

97. Dec. 17, bet. 4.30 and 4.40 A.M.: *Huyton* (L.).—(*Liverpool Courier*, Dec. 18.) Several persons were roused by the shaking of their beds and the rattling of furniture.

98. Dec. 17, ab. 4.30 A.M.: *Cardiff* (Gm.).—(*Daily Telegraph*, Dec. 18.) Apparently a sh. felt.

99. Dec. 17, 4.20 A.M.: Weymouth (Do.).—(c. by Mrs. L. B. Weldon.) A sh. felt.

100. Dec. 17, 4.20 A.M.: Hertford (Hf.).—(c. by Mr. R. T. Andrews.) A distinct lifting of the bed.

101. Dec. 17, 4.35½ A.M.: Hertford (Hf.).—Mr. R. T. Andrews. The bed was shaken up and down and slightly in the direction of N.E. and S.W. for 2 secs: no so. heard.

102. Dec. 17, bet. 4 and 5 A.M.: Hertford (Hf.).—Mr. L. McMullen (*Hertfordshire Mercury*, Hertford, Dec. 19). A sh. felt.

103. Dec. 17, ab. 4.30 A.M.: Ashby-de-la-Zouch (Lc.).—(*Leicester Chronicle*, Dec. 19.) A sh. felt.

104. Dec. 17, bet. 4 and 4.30 A.M.: Nottingham (Nt.).—(c. by Mr. J. Vice.) A trembling of the bed, but no so.

H. DEC. 17, ABOUT 5 A.M.

105. *Hereford* (H.).—(c. by Mr. J. Hartree.) 3. ab. 5 A.M. 4. a sh., strong enough to startle cattle, horses, etc.

106. *St. Michael's Cathedral Priory* (H.).—Anon.* (c. by Rev. Canon E. Hilary Willson.) 3. 4.50. 4. sh. felt. 7. a slight noise as of a rat skurrying away.

107. *Whitchurch* (Sh.).—(*Oswestry and Border Counties Advertiser*, Dec. 23.) 3. 5. 4. sh. felt.

108. *Oxford* (Ox.).—(*Oxfordshire Weekly News*, Chipping Norton, Dec. 23.) 3. ab. 5. A noise heard, but no vibr. perceptible.

109. *Witney* (Ox.).—Anon. 3. ab. 4.45. 6. 4.

110. *Stonycroft Grange* (Ch.).—Mrs. Dambrill-Davies. 3. soon after 5.5. 4. the movement as though a threshing-machine were shaking the bed. 7. no noise heard.

111. *Newtown* (Mo.).—Mr. W. Cooke. 3. 5. 7. a noise like a strong gust of wind.

112. *Cerne Abbas* (Do.).—(c. by Rev. H. D. Gundry.) 3. ab. 4.45. 4. a shaking.

I. DEC. 17, ABOUT 5.20 A.M.

113. *St. Michael's Cathedral Priory* (H.).—Anon.* (c. by Rev. Canon E. Hilary Willson.) 3. ab. 5.20 A.M. 4. a slight motion. 7. so heard.

114. *Badgeworth* (Gc.).—Anon.* (c. by Mr. W. B. Cooper.) 3. ab. 5.20. 4. a violent bump or jerk. 7. no so. heard.

115. *Bentham* (Gc.).—Mr. W. B. Cooper. 3. ab. 5.20. 4. a violent bump.

116. *Swansea* (Gm.).—(*Herald of Wales*, Swansea, Dec. 19.) 3. 5.15. 4. as if people in the adjoining house were moving their furniture.

PRINCIPAL SHOCK: 5.32 A.M.

J. DEC. 17, ABOUT 5.40 or 5.45 A.M.

117. *Dilwyn* (H.).—Rev. F. Mellor. 3. ab. 5.47 A.M. 4. no vibr. felt. 7. a rumbling so.
118. *Much Marcle* (H.).—Mr. T. Charles. 3. ab. 5.47. 7. a slight rumbling.
119. *Putley* (H.).—Rev. J. C. Maca. 3. ab. 5.47. 4. a trem. mot. 5. 2 or 3 secs.
120. *Putley Court* (H.).—Mr. J. Riley. 3. ab. 5.42. 4. a very mild trem. mot.
121. *Bentham* (Gc.).—Mr. W. B. Cooper. 3. ab. 5.39. 4. a trem. mot. 7. no so.
122. *Tortworth* (Gc.).—Mr. H. Kingscote. 3. several mins after prin. sh. 4. no vibr. 7. a slight noise lasting ab. 8 secs.
123. *Great Malvern* (Wc.).—Mr. H. Dyke Acland, F.G.S. 3. ab. 5.45. 4. sh. felt.
124. *Handsworth* (St.).—Mr. J. T. James. 3. some mins after prin. sh. 4. the bed raised. 5. $1\frac{1}{2}$ secs.
125. *Holt* (Dn.).—Mr. J. T. Sheppard (c. by Mr. J. Lomas). 3. 5.37. 4. a tremor. 7. no so.
126. *Newtown* (Mo.).—Mr. W. Cooke. 3. ab. 5.37. 4. a slight upheaving of the bed.
127. *Swansea* (Gm.).—Capt. Colquhoun. 3. some mins after prin. sh. 4. a quivering motion.
128. *Exeter* (D.).—C. Fursdon. 3. 5.55. 4. a slight vibr. 7. a hissing rushing so.
129. *Aldershot* (Ha.).—M. Fountain. 3. ab. 5.48. 4. a slight tremor.
130. *Dulwich* (Sr.).—(*Standard*, Dec. 18.) 3. ab. 5.49. 4. a slight vibr. reported.
131. *Rothamsted* (Hf.).—(c. by Lieut.-Col. E. Durnford.) 3. ab. 5.40 or 5.41. 4. a slight sh.
132. *Kings Sutton* (Nh.).—M. E. Hunt. 3. 5 or 10 mins after prin. sh. 4. a slight sh.

K. DEC. 17, ABOUT 6.15 A.M.

133. *Old Gore* (H.).—Mrs. Herbert. 3. ab. 6 A.M. 4. no sh. 7. distant rumblings.
134. *St. Michael's Cathedral Priory* (H.).—(c. by Rev. Canon E. Hilary Willson.) 3. ab. 6.15. 4. several fancied they felt a slight tremor. 7. no so.
135. *Stretton Grandison* (H.).—Rev. C. E. Hopton. 3. ab. 20 mins after prin. sh. 4. no sh. felt. 7. a rumbling so.
136. *Turrington*, ab. 1 mile W. of (H.).—(c. by Mr. J. H. Wood.) 3. ab. 6.15. 4. a slight tremor.
137. *Cheltenham* (Gc.).—(*Gloucestershire Echo*, Cheltenham, Dec. 17.) 3. ab. 6. 4. a gentle quiver.

138. *Hempstead* (Gc.).—(c. by Mr. F. A. Jones) 3. ab. 20 mins after prin. sh. 4. sh. felt.
139. *Norton* (Gc.).—(c. by Rev. R. Marks) 3. ab. 6. 4. a slight sh. 7. no so.
140. *Sandywell* (Gc.).—Mr. C. W. Laurence. 3. ab. 6.15. 4. sh. felt.
141. *Tewkesbury* (Gc.).—Miss E. C. Sargeaunt. 3. ab. 6.25. 4. a slight sh.
143. *Monmouth* (M.).—(c. by Mr. E. H. Culley.) 3. after 6. 4. sh. felt.
144. *Porthkerry* (Gm.).—(c. by Rev. Canon E. E. Allen.) 3. ab. 6. 7. a noise as of rushing wind.
145. *Southampton* (Ha.).—(*Daily Chronicle*, Dec. 18.) 3. 6.3. 4. a distinct sh.
146. Dec. 17, 6.40 A.M.: Great Malvern (Wc.).—Anon.* (c. by Mr. J. G. R. Powell). 4. a vibr. distinctly felt.
147. Dec. 17, ab. 8 A.M.: Moseley (Wc.).—(c. by Mr. F. E. Willcox.) The bed of an invalid shaken.
148. Dec. 17, towards 8 A.M.: Lichfield (St.).—(c. by Rev. C. N. Bolton.) A sh. felt.
149. Dec. 17, ab. 7.40 A.M.: Teddesley Hall (St.).—Mr. A. C. Littleton. Another slight rattling of the furniture.

The following are records of miscellaneous observations of minor shocks on Dec. 17, the time-data being insufficient to allow them to be placed under their proper headings.

150. Ross (H.).—(*Ross Gazette*, Dec. 17.) Two slight shs. have been felt in the district since the prin. sh.
151. Cliffords Mesne (Gc.).—Mr. O. T. Price. Three distinct tremors within half an hour of the prin. sh., acc. by a low rumbling so.
152. Clifton (Gc.).—(*Birmingham Daily Gazette*, Dec. 18.) In the centre of the city, a slight preliminary sh. was felt.
153. Dursley (Gc.).—Miss C. Cooke. There were certainly tremors on Dec. 16 and on Thursday night (Dec. 17-18). On Dec. 17 there were several tremors, but unaccompanied by so.
154. Minchinhampton (Gc.).—Mr. F. Fowler. One slight sh. f. the prin. sh.
155. Hanbury (Wc.).—(c. by Rev. C. W. N. Ogilvy.) Several residents say that there were slight shs. before, and one after, the prin. sh.
156. Moseley (Wc.).—Miss L. M. Pumphrey. Some time before the prin. sh., another sh. was felt.
157. Little Wenlock (Sh.).—(c. by Mr. L. S. Hollings.) An earlier and slighter sh.
158. Shirenewton (M.).—(c. by Mr. E. J. Lowe, F.R.S.) Two minor shs. were felt by one obs., one at 3 A.M. and the other before the severe sh.
159. Birmingham (W.).—Miss E. Ryland. Bet. 5 and 5.30 A.M., ab. 4 or 5 noises like small explosions.

160. Wolverhampton (St.).—Mr. J. W. Hunt.† Obs. was awakened in the night by a loud rumbling as though heavy machinery had just passed; the noise lasted ab. 15 or 20 secs., and seemed to travel E. and W.

161. Heswall (Ch.).—Mr. J. Doak (c. by Mr. J. Lomas). The obs. awoke at 4.30 A.M.; heavy hail showers were falling and now and again a tremor was felt; the early vibra. began ab. 5.15 A.M. and continued at regular intervals of ab. 5 mins. until the prin. sh. was felt at 5.42.

162. Newtown (Mo.).—(c. by Rev. E. A. Fishbourne.) Earlier in the night a quivering motion was felt.

163. Mountain Ash (Gm.).—(c. by Mr. M. Morgan.) An earlier sh. is said to have occurred.

164. Matlock Bath (Dr.).—Mr. R. W. Hackwood. Three or four upheavings of the bed were felt within 4 or 6 mins. after the prin. sh.

The following eight records refer to some disturbances observed after Dec. 17.

165. Dec. 18, bet. 4 and 5 A.M.: Chorlton-on-Medlock (L.).—4. Anon.* a very slight, but distinct quiver of the earth. 5. ab. $1\frac{1}{2}$ secs.

166. Dec. 19, ab. 0.30 A.M.: Avenbury (H.).—Anon. A very slight sh.

167. Dec. 20, ab. 7.30 P.M.: Great Witley (Wc.).—Mr. J. Twinberrow. The obs. was sitting with his chair touching the wall, and distinctly felt the wall quiver, although no vehicle was passing along the road.

168. Dec. 20, ab. 11.15 P.M.: Boulton (R.).—E. Moberly. The obs. thought there was a slight sh.

169. Dec. 23, 0.30 P.M.: Westbury-on-Severn (Gc.).—(c. by Mr. E. Prevost.) A man walking up the street felt the sh.: the motion was lateral, and was accompanied by a so. like wind. This sh. was also felt at another house two miles away.

170. Dec. 26 or 27: Street Court (H.).—(c. by Mr. J. Southern.) A report came this morning [Dec. 27] to the effect that an earthquake was felt at Street Court last night.

171. Dec. 31: Shirenewton (M.).—Mr. E. J. Lowe, F.R.S. A slight earthquake.

172. Jan. 1, 1897, ab. 4.5 A.M.: Charlton Kings (Gc.).—Mr. S. S. Buckman, F.G.S.† Awakened by a noise and shaking as if a very strong wind were shaking the house. The strongest gales make very little impression on this house.

It is somewhat doubtful whether the next eight records are those of a real earthquake. The majority of the observers certainly were of that opinion immediately after the occurrence. But, as Mr. H. Cecil Moore informs me (and one of the observers makes a remark to the same effect), the morning was a boisterous one, with winds and occasional storms, and the phenomena recorded may perhaps have been due to thunder or violent wind. As the evidence of its seismic character is not conclusive, I have therefore thought it best to enter it under the heading of "doubtful shocks."

173. Mar. 18, 1898 : Bacton (H.).—(c. by Mrs. Attwood-Mathews.) A rumbling noise acc. by a great rush of wind.

174. Mar. 18 : Hereford.—(Do.) Three distinct rumblings heard.

175. Mar. 18, 5.15 A.M. : Pontrilas Court (H.).—Mrs. Attwood-Mathews. A slight sh. wh. shook the window of the room, and a rumbling so. Fifteen minutes later, a much slighter rumbling.

176. Mar. 18 : Pontrilas Court (H.).—(c. by Mrs. Attwood-Mathews.) Several persons noticed three shs., at ab. 4, 5.15, and 5.30 A.M. ; one heard three rumblings at these times.

177. Mar. 18, 5.35 A.M. : Newland (Gc.).—Miss G. Blandy. 4. the room shook and the roof rattled. 7. yes.—The sh. was repeated and imm. f. by thunder and lightning.

178. Mar. 18, 5.35 A.M. : do.—Miss M. Bosanquet.† 4. sh. felt.

179. Mar. 18 : Dingestow (M.).—(c. by Miss M. Bosanquet.) Several persons thought there was an eq.

180. Mar. 18 : Monmouth.—(Do.) Several persons thought there was an eq.

L. JULY 19, 1897, 3.49 A.M.

181. *Bridstow* (H.).—Mr. E. Armitage (*Nature*, vol. 56, 1897, p. 347). 3. 3.50 A.M. 4. a distinct sh. g. E. to W. 5. momentary. 7. a rumbling so. acc. the sh.

182. *Hereford* (H.).—Dr. Fitzsimons * (c. by Mr. H. Cecil Moore). 3. bet. 3.30 and 4 A.M. 4. a. yes b. one d. grad. incr. 5. ab. 10 secs. 7. distant thunder or a carriage. b. p. d. yes e. f.

183. Do.—Mrs. Berthoud.† 4. the house shaken as if by a passing vehicle. 7. a so. as of boxes slipping, and then of a cab or carriage driven quickly and stopped suddenly.

184. Do.—Anon.* (*Hereford Times*, July 24). 3. 3.50 A.M. 4. a slight tremor. 5. very short. 6. pr. 4. 7. a dull explosion, f. imm. by tremor.

185. *Ashleworth* (Gc.).—(c. by Rev. B. Edwards.) 3. 3.46 A.M. 4. the house shook as if a heavy traction-engine were passing close by. 6. 4. 7. the so. began suddenly and died away : it lasted ab. 5 secs.

186. *Barnwood* (Gc.).—Rev. F. H. Fowler. 3. 3.46 A.M. 4. no sh. 7. a dull heavy rumbling, f. by a noise like the passage of a train ; it lasted ab. 5 secs. and appeared to come from the S.E.

187. *Great Malvern* (Wc.).—Mr. Crudge (c. by Mr. J. G. R. Powell). 3. 3.49. 4. beds shaken. g. N. to S. 6. 4.

188. Do.—Miss Pittar (do.). 4. a slight but decided sh. 7. a very slight noise.

189. Do.—Dr. Jacob * (do.). 3. 3.49. 4. sh. felt. 5. ab. 10 secs. 7. a distant low booming like a cannonade.

190. Do.—Mr. T. A. Bonser * (do.). A slight eq.

CHAPTER IV

INSTRUMENTAL RECORDS

THE instrumental records are few in number and add very little to our knowledge of the earthquake. The most important are those obtained by two of Prof. Milne's seismographs at Shide, in the Isle of Wight. The principal shock was also registered by magnetographs at Kew, and at a few places by the long and delicately balanced arms of self-recording meteorological instruments.

At Shide, the booms of the seismographs, as Prof. Milne remarks, "were not slowly tilted from side to side, as is the case when they record earthquakes originating at a great distance, but merely set in a state of elastic vibration." The movements were extremely small, and, on the photographic record, appear merely as an intermittent thickening of a line traced by a spot of light, which is perfectly straight when there is no disturbance. The tremors began about 11 P.M. on Dec. 16 and lasted for about twelve hours, but they differed from an ordinary tremor-storm in not being continuous. The duration of each group is from one to about six minutes, and they were separated by intervals of five to sixty minutes. The approximate times of a few of these groups of tremors are:—Dec. 16, about 11 P.M.; Dec. 17, after 2 A.M.; at 3 A.M., two groups; 4 to 6 A.M., an intermittent series with a maximum about 5.30; between 6 and 7 A.M., two groups; the last group being at about 10 A.M. Besides these, other tremors were recorded, some by one instrument only, others by both. Prof. Milne gives the following list of tremors which are recorded nearly simultaneously by the two seismographs:—2.4, 2.12, 2.37, 3.54, 4.25, 4.42, 5.10, 5.55, 6.8½, 9.21, 10.42 A.M.¹

Whether there was any connexion between these disturbances and the slight shocks which preceded and followed the Hereford earth-

¹ *Brit. Assoc. Rep.* 1897, pp. 36-38. I have quoted the times to the nearest minute only, as determined from the records of one instrument. Those of the other differ by amounts varying from about one to six minutes.

quake, it is, unfortunately, impossible to determine. The times at which the latter occurred are only known approximately; so roughly, indeed, that it is not always easy to group together observations of the same shock. Some, though not all, of the times agree fairly with those mentioned by Prof. Milne; but, when several disturbances are noted within so brief an interval, some approximate coincidences are unavoidable. As the principal earthquake was felt by several persons in the Isle of Wight, it could hardly fail to be registered by Prof. Milne's delicate instruments, and it therefore seems probable that this shock may be correlated, in part at any rate, with the disturbance whose maximum occurred at about 5.30 A.M. But the connexion between the minor shocks and the other tremors recorded at Shide must, I fear, be regarded as doubtful.

The records of the magnetographs at Kew and Stonyhurst were carefully examined for traces of the earthquake by Dr. C. Chree and the Rev. W. Sidgreaves. At the latter place there were no movements discernible, but those which were clearly due to changes of magnetic direction and force. At Kew, however, the effect of the earthquake "was shown slightly on the declination curve, and more distinctly on the horizontal force curve. . . . The time of commencement was 5 h. 35 m. A.M. (± 1 minute) G.M.T. The disturbance on the horizontal force curve approximately equalled what would have been produced by a change of 0.00004 C.G.S. units in that force."¹ According to the Astronomer-Royal, the reflecting galvanometer for registering earth-currents at Greenwich showed no indications of disturbance.²

At Broomy Hill, near Hereford, the pen of a barograph belonging to Mr. T. F. Symonds made a small hole in the paper on which the changes of pressure are recorded. The barograph sheet at the Edgbaston Observatory, Birmingham, as Mr. A. Cresswell has kindly informed me, was marked by the shock, but "the clock, or rather the position of the paper on the drum, was fast, and unfortunately, before I knew of the earthquake, I had put the next day's sheet on." There is also a small horizontal mark on the rain recorder of the anemometer, and this gives the time of occurrence between 5.30 and 5.35. At Greenwich, two small marks were made on the barograph record at about half-past five. At the same time, also, the clock of a waste-water meter at Droitwich stopped, and the pencil dug into the indicating-paper and ripped it up for several inches. On the other hand, the trace of a barograph so near the centre as Gloucester showed no sign of disturbance,³ nor did that of a similar instrument at Leeds. At Berkhamstead, in Hertfordshire, Mr. E. Mawley remarked no disturbance of the pencils or pen of any of his meteorological instru-

¹ Dr. C. Chree, *Nature*, vol. 55, 1896, p. 178.

² *The Times*, Dec. 18, 1896.

³ *Nature*, vol. 55, 1896, p. 179.

ments, "not even on the trace of the self-recording rain-gauge, which is sunk more than a foot deep in the ground."¹

The remaining evidence is entirely of a negative character. The mounting of a 4-inch equatorial telescope belonging to Mr. G. Banaster at Myth Hill, near Tewkesbury, was not affected by the earthquake. Nor, as the corrections before and after show, was there the least perceptible shift of the transit-instrument at Cambridge.² At considerable distances from Hereford are several of the new instruments adapted for recording distant earthquakes,—a bifilar pendulum at Edinburgh, horizontal pendulums at Strassburg, Casamicciola (Ischia), and Nicolaiew (in the south of Russia), and different forms of long vertical pendulums in Italy,—but none of these showed any trace of the shock.

One conclusion may be drawn from this negative evidence, namely, that the long low waves, during the passage of which the ground rocks slowly to and fro through a very small angle, were absent from the Hereford earthquake, or, if present, were too small to be measured.

¹ *Hertfordshire Nat. Hist. Soc. Trans.* vol. 9, 1897, pp. 186-187.

² *Ibid.* p. 203.

CHAPTER V

ORIGIN OF EARTHQUAKES AND METHOD OF INVESTIGATION

I PROPOSE in this chapter to give a brief account of the modern theory of the origin of earthquakes, the theory which regards them as mere incidents in the growth of faults, and under whose guiding light these and other British earthquakes have been investigated.

The history of the theory is involved in some obscurity, and I am unable to determine to whom we are indebted for the first suggestion. Probably the theory is of multiple origin, as in so many other cases in which evidence has been unconsciously collected. It would, indeed, be strange if it failed to occur to any one who reflected on the formation of the great faults which traverse the earth's crust. We know how slowly these faults grow. Of the majority, no trace is visible on the surface, unless it should happen that, by their means, rocks of different degrees of hardness are exposed on either side of the fracture. The downward displacement along some faults is to be reckoned in miles, the lengths of the faults themselves in scores of miles. It is inconceivable that movements so vast as these could have been accomplished at a single stroke. Rather must they be the results of an almost infinite number of elemental slips, now in one part of the fault-surface, now in another, each slip being paroxysmal in its occurrence, but due to causes which, if not absolutely uniform in their action, are yet most slow and gradual. Whenever such a slip takes place, the friction generated by the sudden sliding of one huge mass of rock over and against the other must produce an intense jar in the solid crust around, a series of vibrations which, propagated outwards in all directions, produces at the surface what we call an earthquake-shock.

Reality of the Connexion between Earthquakes and Faults

Earthquakes are thus inevitable consequences of the formation of faults, but it does not follow without further proof that more than a

few of our present-day shocks are actually produced in this manner. I exclude from consideration those earthquakes which are directly volcanic in their origin, though even these may occasionally be due to fault-slipping; also the series of minor shocks which in some places are caused by the fall of rock-fragments in underground channels. I admit freely too that there may be many earthquakes whose modes of origin are as yet hidden from us. My object is merely to show that a very large number, perhaps the majority, of those which affect the non-volcanic regions of the globe are intimately connected with the slow but effectual process of fault-growth.

(1) The first fact I will refer to is the elongated form of the disturbed area and the isoseismal lines. When the observations which determine them are numerous and exact, these curves are nearly always oval or elliptical in form, approaching circularity with few but the slightest shocks,¹ and not even with all of these. I will take first some cases of earthquakes in this country. In the Inverness earthquake of Nov. 15, 1890, the lengths of the longer and shorter axes of the completely drawn isoseismals are 48 and 37 miles, and $86\frac{1}{2}$ and $61\frac{1}{2}$ miles;² in the Pembroke earthquake of Aug. 18, 1892, 172 and 136 miles, and 255 and 225 miles;³ in the Leicester earthquake of Aug. 4, 1893, $17\frac{1}{4}$ and 12 miles, 47 and 34, and 58 and 46 miles;⁴ in the Pembroke earthquake of Nov. 2, 1893, 41 and 28 miles, 233 and 196, and 313 and 269 miles;⁵ and in the Exmoor earthquake of Jan. 23, 1894, $22\frac{3}{4}$ and $12\frac{1}{4}$ miles, and $29\frac{3}{4}$ and $16\frac{1}{2}$ miles.⁶ In each case, also, it is important to notice that the longer axes of the isoseismal lines, though not absolutely coincident, agree very closely in direction.

Turning to the earthquakes of other lands, we find that many of the most important originated so nearly under the coast-line that the isoseismals are in great part incomplete. It would not be difficult, however, to quote numerous cases which show that the same laws hold true. For instance, in the Neapolitan earthquake of 1857, the dimensions of the isoseismal lines are 64 and 23 miles, 71 and 47, and 103 and 82 miles;⁷ in the Andalusian earthquake of Dec. 25, 1884, the area of greatest damage is 40 miles long and 28 miles broad;⁸ in the Verny (Turkestan) earthquake of June 9, 1887, the dimensions of

¹ When strong, or moderately strong, earthquakes can be traced to a considerable distance from the origin, the outer isoseismals may be roughly circular, as in the case of the Hereford earthquake discussed in this work. (See the next chapter.)

² *Quart. Journ. Geol. Soc.* vol. 47, 1891, pp. 619, 622.

³ *Ibid.* vol. 53, 1897, p. 160.

⁴ *Roy. Soc. Proc.* vol. 57, 1895, p. 88.

⁵ *Quart. Journ. Geol. Soc.* vol. 53, 1897, p. 169.

⁶ *Geol. Mag.* vol. 3, 1896, p. 555.

⁷ R. Mallet, *Great Neapolitan Earthquake of 1857*, vol. 2, Map B. These, and some of the following, measurements are made from the curves traced on the maps of the earthquakes.

⁸ T. Taramelli and G. Mercalli, *R. Acc. dei Lincei, Atti*, ser. 4, vol. 3, 1886, p. 48.

the isoseismals are 52 and 27 miles, and 950 and 563 miles;¹ in the Greek earthquake of April 20, 1894, 17 and 5 or $5\frac{1}{2}$ miles, and 56 and 40 miles;² and in the Constantinople earthquake of July 10, 1894, 109 and 24 miles, 154 and 46, and 220 and 109 miles.³

The elongated form of the disturbed area is especially characteristic of the earthquakes of countries in which the mountain-ranges are of recent origin. In Switzerland, for example, the dimensions of the disturbed areas of six earthquakes in 1879 and 1881 are 87 and 37 miles, 186 and 93, 93 and 50, 161 and 96, 224 and 109, and 130 and 56 miles;⁴ the lengths in these cases being roughly twice as great as the breadth. Again, in the Nepal earthquake of 1833, the dimensions are 916 and 494 miles;⁵ in the Burmese earthquake of 1858, 1454 and 776 miles;⁶ and in the Bengal earthquake of 1885, 689 and 413 miles.⁷

Two explanations of the elongation of the disturbed area have been offered, one that the seismic focus is of considerable length and parallel to its longer axis; the other that the vibrations are transmitted with greater ease in this direction. It is not difficult to argue in favour of the latter explanation. The longer axes of the disturbed areas are generally parallel to mountain-ranges, and the rocks along their axes may be more continuous, there may be fewer bounding surfaces to be crossed, than in the perpendicular direction. No one who has studied the admirable collections of seismographic records recently made in Japan can be blind to the fact that the intensity of the vibrations is influenced by the nature of the rocks they traverse. Nevertheless, if the explanation were correct, the isoseismals of an earthquake should be approximately similar in form, and so also should be the disturbed areas of different earthquakes in the same region; and this, as the above figures clearly show, is very far from being the case. Moreover, in one and the same region, the longer axes of different earthquakes are sometimes at right angles to one another; and this fact is clearly fatal to the generality of the explanation.

While fully admitting, then, that the forms of the isoseismals must be modified by the nature of the surface-rocks, we are led, I think, to the alternative explanation, namely, that the seismic focus is of considerable length and is approximately parallel to the longer axes of the isoseismals. It is evident, if this be the case, that the inner isoseismals

¹ J. V. Mouchketow, *Mém. du Comité Géologique*, vol. 10, no. 1, map.

² S. A. Papavasiliou, *Paris Acad. Sci. Compt. Rend.* vol. 119, 1894, pp. 112-114, 380-381; *Nature*, vol. 50, 1894, p. 607.

³ D. Eginitis, *Annales de Géogr.* (Paris), 4^e année, 1895, pp. 154-155; *Natural Science*, vol. 8, 1896, p. 28.

⁴ F. A. Forel, *Arch. des Sciences phys. et nat.* vol. 6, 1881, pp. 471, 473; vol. 11, 1884, pp. 151, 153, 155.

⁵ T. Oldham, *Geol. Surv. of India Mens.* vol. 19, 1883, pt. 3.

⁶ *Ibid.*

⁷ C. S. Middlemiss, *Geol. Surv. of India Records*, vol. 18, pt. 3.

should adhere more closely to the form of the focus and should therefore be the more elongated; while the outer isoseismals, so far as can be drawn, should approach more and more nearly to circularity. That this is the case is fully borne out by the dimensions of successive isoseismals given above and of many others that might be quoted.

(2) The significance of the elongated forms of the isoseismals is rendered more apparent when they are plotted on a physical or geological map. Their longer axes are then generally seen to be either parallel or perpendicular to the axes of mountain-chains, to the main lines of folding or to the chief faults of the district. For instance, the longer axes of the isoseismals of the Leicester earthquake of Aug. 4, 1893, are parallel to the anticlinal axis of Charnwood Forest.¹ In the north of Cornwall, the main lines of folding run roughly east and west, and the longer axis of the disturbed area of the Cornish earthquake of Oct. 7, 1889, is in that direction, while that of the earthquake of Mar. 26, 1891, in the same district runs north and south.² In the principal Pembroke earthquake of Aug. 18, 1892, the longer axes of the isoseismals are directed north and south, i.e. at right angles to the strike faults of the district, while the axis of the disturbed area of an accessory shock on Aug. 22 is nearly parallel to, and coincident with, one of these faults.³ Indeed, the longer axes of the disturbed areas of nearly all the more important British earthquakes of the last decade are parallel either to the strike faults or transverse faults of the respective epicentral regions.⁴

In other countries, the examples of this relation are extremely numerous. I will mention merely a few of the more recent cases. In most of the Swiss earthquakes with elongated areas, the longer axes are parallel to the neighbouring chains of the Alps and Juras, though in a few instances they are in the perpendicular direction.⁵ The longer axes of the Greek earthquakes of April 20 and 27, 1894, are parallel to the neighbouring depression of the Gulf of Eubœa.⁶ The axis of the innermost isoseismal of the Constantinople earthquake of July 10, 1894, coincides with the line of depression which begins at Ada-Bazar and is marked by the Lake of Sabandja and the Gulf of Ismid.⁷ In nearly all the recent earthquakes of Roumania and the adjacent Balkan States, the longer axes are parallel to prominent faults (see

¹ *Roy. Soc. Proc.* vol. 57, 1895, pp. 88-89.

² *Geol. Mag.* vol. 8, 1891, p. 370; vol. 9, 1892, pp. 300-301.

³ *Quart. Journ. Geol. Soc.* vol. 53, 1897, pp. 160-161, 168.

⁴ *Ibid.* vol. 47, 1891, pp. 620, 624-627; vol. 53, 1897, pp. 167, 169, 172; *Geol. Mag.* vol. 8, 1891, p. 368; vol. 10, 1893, pp. 293-294, 297-298; vol. 3, 1896, pp. 76-77, 555.

⁵ F. A. Forel, *Arch. des Sciences phys. et nat.* vol. 6, 1881, pp. 461-494; vol. 11, 1884, pp. 147-182; vol. 13, 1885, pp. 377-396.

⁶ S. A. Papavasiliou, *Paris Acad. Sci. Compt. Rend.* vol. 119, 1894, pp. 112-114, 380-381; *Nature*, vol. 50, 1894, p. 607.

⁷ D. Eginitis, *Annales de Géogr.* (Paris), 4^e année, 1895, pp. 154, 164; *Natural Science*, vol. 8, 1896, pp. 27-33.

Fig. 7).¹ The meizoseismal area of the Tokio earthquake of June 20, 1894, is a north-and-south band which occupies the lowest part of the Plain of Musashi, the plain itself being the continuation of the axis of the Bay of Tokio.² In the great Japanese earthquake of Oct. 28, 1891, the meizoseismal area is a sinuous band following in great part the course of the remarkable fault-scarp, which will be referred to in a later section of this chapter.³

The conclusion to which the above facts lead is obviously that earthquakes are closely related to one or both of the two processes of folding and fracturing by means of which mountain-ranges are made and to which the outlining of the earth's great surface-features is chiefly due. But the fact that, in a given district, the axes of the disturbed areas are parallel not to one line only, but to two lines roughly at right angles to one another, seems to indicate that they are not directly connected with the great folds and mountain-axes, but rather with the double system of faults which, it is well known, have a tendency to cross at right angles, one series being approximately parallel, and the other perpendicular, to the main lines of folding.

(3) When successive earthquakes in a district are mapped, the epicentral areas are sometimes found to be nearly coincident or concentric and coaxial;⁴ at other times, the epicentre is displaced, and the axes of the new isoseismals may then be either parallel or perpendicular to those of the old ones or else in the same straight line with them. To take some British examples first. The Pembroke earthquake of Aug. 18, 1892, at 0.24 A.M., was followed by eight minor shocks. One of these, occurring at about 2.50 A.M. on the same day, had its longer axis approximately parallel to that of the principal earthquake and about three miles farther west. This was followed by a shock at about 4 A.M., whose longer axis is roughly east and west; while the next shock but one, which took place on Aug. 22 at about 11.55 A.M., had its axis parallel to that of the latter and about $1\frac{1}{2}$ miles more to the north.⁵ On May 16, 1892, at about 10.30 P.M., a very slight shock was felt in the south-west of Cornwall, disturbing a nearly circular area; three hours later, another and stronger shock occurred, the longer axis of the inner isoseismal runs east and west and the centre of the curve is three miles west of the centre of the first area.⁶ Again, in the Pembroke earthquake of Nov. 2, 1893, the isoseismal of the principal shock is 41 miles long and 28 miles broad, the longer axis being directed E. 15° N. and W. 15° S. Sixteen minutes later, the

¹ Math. M. Draghicénu, *Les Tremblements de Terre de la Roumanie et des Pays Environnants* (Bucharest, 1896), pp. 67-73.

² F. Omori, *Boll. della Soc. Sismol. Ital.* vol. 2, 1896, pp. 181-182.

³ B. Koto, *Journ. Coll. Sci. Imp. Univ. Japan*, vol. 5, 1893, pl. xxix.

⁴ *Quart. Journ. Geol. Soc.* vol. 47, 1891, p. 620 (cf. the curves of the accessory shocks marked b, d, K).

⁵ *Ibid.* vol. 53, 1897, pp. 167-168.

⁶ *Geol. Mag.* vol. 10, 1893, pp. 296-297.

first minor shock occurred ; the disturbed area is 43 miles long and 29 miles broad, its longer axis runs E. 25° N. and W. 25° S., and the centre of this curve lies about 8 miles W. 20° S. of the centre of the former.¹

The displacement of the epicentre is a fact which has long been known to characterise the shocks of the more distinctly seismic

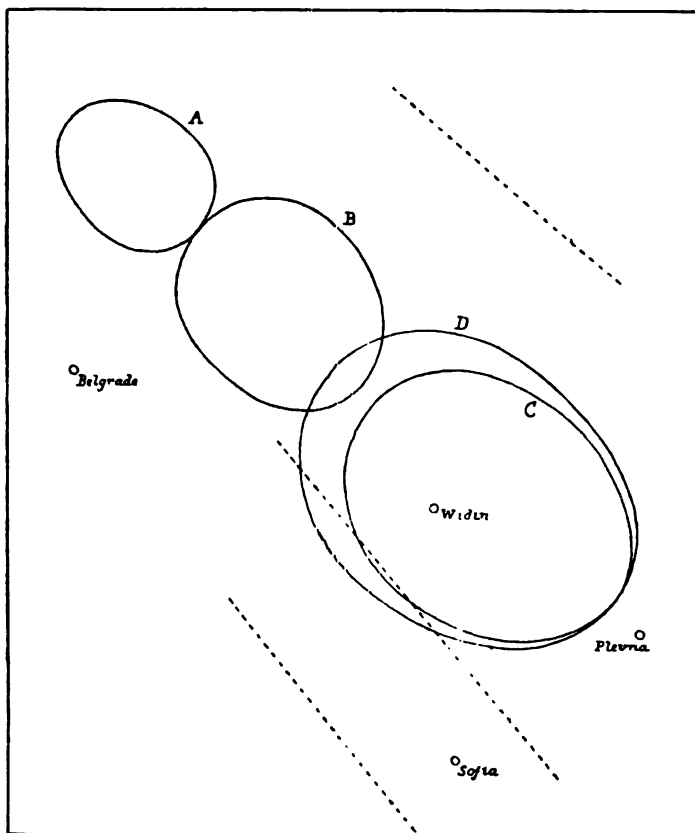


FIG. 7.—Map of Earthquakes in the Balkan peninsula, illustrating the "Displacement of the Epicentre."

countries, but I am not acquainted with many cases in which the areas have been carefully traced. One of the most interesting is a series of earthquakes in the Balkan peninsula studied by M. Draghicénu. In the accompanying sketch-map (Fig. 7) are shown the inner isoseismal lines of four of these earthquakes occurring, A on

¹ *Quart. Journ. Geol. Soc.* vol. 53, 1897, pp. 169, 172.

Oct. 31, 1873 (?), B on Oct. 10, 1879, C on April 8, 1893, and D on Sept. 8, 1893. The straight lines represent some of the faults of the district, and it will be noticed that not only are the axes of the isoseismals parallel to these faults, but that they are in one and the same straight line.¹ It is difficult, I think, to resist the conclusion in this case that the earthquakes are connected with a fault not shown on the map, but parallel to those whose courses are there traced.

(4) As faults are always inclined to the horizon and the centre of the seismic focus is generally at a depth of at least a few miles, it is evident that the epicentre of an earthquake connected with a fault should lie on that side of the fault-line towards which the fault fades. It is not often that isoseismal lines can be drawn with sufficient accuracy to show this; indeed, it is only in thickly populated countries like England where such accuracy is attainable. But in several earthquakes during the last decade which I have studied, not only is the longer axis of the inner isoseismal parallel to a neighbouring fault-line, but it lies on that side of the line towards which the fault fades.²

(5) Lastly, a few violent earthquakes have certainly been accompanied by the formation of fault-scarps; and in these cases there can of course be no doubt as to the connexion between the two phenomena. These will, however, be considered more suitably in the next section.

Earthquakes due to Fault-slipping rather than to Fracturing

There appear to be two principal ways in which earthquakes may be produced during fault-formation, either by the mere act of fracturing, or, as already suggested, by the friction generated by slipping. Possibly slipping may take place immediately after the fracturing so that a single earthquake might be due in part to both causes. I will now give some reasons, however, for concluding that the vast majority of earthquakes are due to fault-slipping.

(1) During the actual fracturing which initiates a fault very few earthquakes could be produced, one by the first fracture and a few more by its further extension. But the subsequent displacement must be the result of innumerable slips. Now, the number of earthquakes originating in a given district is enormously in excess of the number of faults in it, and the inequality will be the more evident if we consider that in many districts faults have been in process of formation during a large part of geological time, while our earthquake-records only extend over a few centuries, often over only a few years.

¹ Math. M. Draghicénu, *Les Tremblements de Terre de la Roumanie et des Pays Environnants* (Bucharest, 1896), Pl. I.

² *Quart. Journ. Geol. Soc.* vol. 47, 1891, pp. 624, 625, 627; vol. 53, 1897, pp. 167, 168; *Geol. Mag.* vol. 8, 1891, pp. 65-66, 314. See also *Roy. Soc. Proc.* vol. 57, 1895, p. 88; *Geol. Mag.* vol. 3, 1896, pp. 78-79.

For instance, 143 shocks and sounds were noted at Comrie, in Perthshire, during the last three months of 1839;¹ 306 shocks were felt in the island of Zante during the year 1896;² while at Gifu, in Japan, 3365 shocks were recorded between Oct. 28, 1891 (when the great earthquake occurred), and the end of the year 1893.³ There are reasons for connecting the shocks at all three places with neighbouring faults, and it is quite inconceivable that each shock was caused by the formation of a new fracture or the extension of an old one.

(2) In several cases, though not in many, it is quite certain that fault-slips have taken place during earthquakes, for they have even extended to the surface and been left visible there as fault-scarps. As doubt has been thrown on some of the older observations, I will confine myself to recent cases. During the great Japanese earthquake of 1891, an extraordinary fault-scarp was formed. It was actually traced, cutting through hills and plains, for a distance of 40 miles, and its total length was probably not less than 70 miles. In one part, the vertical displacement reached about 18 or 20 feet, and the scarp, from a distance, had the appearance of a railway embankment.⁴ Moreover, the distribution of earthquake-centres in the epicentral region during the two previous years showed that the fault-system (for there may have been more than one fault in action) was a seat of rather frequent shocks, so that it is improbable that the great earthquake was due to the formation of a new fracture.⁵ Again, the Baluchistan earthquake of Dec. 20, 1892, was accompanied by the formation of a fault-scarp parallel to the Chaman Hills, one side being left two inches higher than the other. The line of this fault has been surveyed for a length of 120 miles, though it does not of course follow that a displacement took place over the whole distance on the occasion referred to. But it is clearly not a new fracture, for the older natives declare that the ground always cracks along this line with every severe earthquake.⁶ Lastly, on April 20, 1894, a strong earthquake was felt in north-east Greece. A week later, on April 27, a still more severe earthquake occurred, and this was accompanied by the formation of a fault-scarp 34 miles long parallel to the depression which forms the Gulf of Eubœa, and with a throw in one part of about five feet. Now, the axes of the isoseismal lines of the two earthquakes coincide very nearly in position and direction, and both were followed for a few days by innumerable slight shocks in the

¹ J. Drummond, *Phil. Mag.* vol. 20, 1842, pp. 240-247.

² S. A. Papavasiliou, *Observ. Nat. d'Athènes Bull. Mensuel Séismol.* 1896.

³ F. Omori, *Japan Seismol. Journ.* vol. 3, 1894, p. 80.

⁴ B. Koto, *Journ. Coll. Sci. Imp. Univ. Japan*, vol. 5, 1893, pp. 295-353.

⁵ *Quart. Journ. Geol. Soc.* vol. 53, 1897, pp. 11-12.

⁶ *Geol. Mag.* vol. 10, 1893, pp. 356-360; C. L. Griesbach, *Geol. Surv. of India Records*, vol. 26, 1893, pp. 57-61; A. H. McMahon, *Quart. Journ. Geol. Soc.* vol. 53, 1897, pp. 291-292.

epicentral region. It would appear, therefore, that the fault existed before April 27, that the principal shocks were produced by great slips along this fault, and the numerous slight shocks by readjustments of the displaced strata or else by further slips due to the increased stress caused at different points by the chief displacements.¹

When a fault-scarp is formed on the bed of the ocean, the sudden translation of a large body of water above it will give rise to a "great sea-wave," for which it would be difficult to account if the earthquake were due to the formation of a mere fracture without vertical displacement.

(3) The shifting of the epicentre outwards in one or both directions might be due to an enlargement of a fracture, but when the epicentre retraces its course, as is sometimes the case (see Fig. 7), the earthquakes in such cases must, I think, be referred to fault-slipping.

(4) Lastly, it is obviously less difficult to generate or precipitate a fault-slip than to make a new fracture; and this is a matter of not a little consequence when we remember that, in all probability, faults are ultimately due to the slow annealing of the earth. Moreover, in the case of fracturing, the initial disturbance is merely the elastic recoil of the rock-particles from the surfaces of fracture; whereas, in the case of slipping, the original disturbance depends on the weight of the displaced mass; and, as this mass may be few or many miles in length and thickness, the friction so generated must evidently be capable of producing earthquakes as slight as those which are felt at Comrie or as disastrous as some of those which visit the coasts of Chili and Japan.

Origin of Earthquake-sounds

In the simplest case of a fault-slip, there will be a central region of the fault-surface where the relative displacement of the two rock-surfaces is a maximum, and this will be surrounded by a region where the relative displacement is very small and gradually dies away towards the edges. The upper marginal region may or may not extend to the surface of the earth; in the lower marginal region, the displacement may or may not diminish actually to zero.

From all parts of the seismic focus there must thus proceed vibrations varying in amplitude and wave-length, and therefore also in their corresponding period. From the central region will be derived the vibrations of larger amplitude and longer period which constitute the principal part of the shock. From the marginal regions will come small and rapid vibrations, which, as we know from seismographic records and also from personal observations, form the commencement of nearly every earthquake and are sometimes superposed on the

¹ S. A. Papavasiliou, *Paris Acad. Sci. Compt. Rend.* vol. 119, 1894, pp. 112-114, 380-381; *Nature*, vol. 50, 1894, p. 607.

larger oscillations. Whether some of the vibrations proceeding from the latter regions may be rapid enough to be perceptible as sound, or rather as a confused rumbling noise, we have no instrumental proof; but that the connexion is a real one seems to me to follow, (1) from the evidence afforded by the time-relations of the sound and shock, and (2) from the completeness with which, on this supposition, we can account for the observed phenomena of earthquake-sounds.

(1) At many places within the disturbed area, but especially at those near the epicentre, the duration of the sound is greater than that of the sensible shock, the sound overlapping the shock at both ends, or else coinciding with it at one end and overlapping it at the other. Now, if the sound-vibrations proceeded from exactly the same region as those of longer period, and at exactly the same time, the beginning and end of the sound would both precede, both coincide with, or both follow, the beginning and end of the shock, according as the velocity of the former vibrations was greater than, equal to, or less than, that of the latter. Hence, if the slip take place instantaneously, the sound-focus must at both ends extend beyond the shock-focus.

The slip, however, might occupy a finite time, say, one or more seconds, beginning and ending with comparative slowness, and at these times generating small and very rapid vibrations, which would probably be sensible as sound before, during, and after the shock. But, if sound-vibrations are initiated in this manner, they must equally be provided by the evanescent movement along the limits of the focus. In either case, then, whether the slip take place instantaneously or not, we are led to the same conclusion, namely, that sound-vibrations must come from the margins of the seismic focus.

(2) The principal phenomena of earthquake-sounds may be summarised as follows:—(i.) The beginning of the sound precedes that of the shock in nearly all parts of the disturbed area; the epoch of maximum intensity generally coincides with that of the shock, but in some places, especially at a distance from the focus, precedes it; while the end of the sound as a rule follows that of the shock, except at considerable distances from the focus. (ii.) The extent of the sound-area is independent of that of the disturbed area. In some districts, sounds are frequently heard while no shocks, or only very slight ones, are felt. When the earthquake is a weak one, the sound-area is approximately coincident with the disturbed area, or may perhaps overlap it. As the shock increases in intensity, the size of the sound-area diminishes roughly with respect to that of the disturbed area, though it bears no fixed proportion to the latter; while, with very violent shocks, the sound-area is a comparatively small region immediately surrounding the epicentre. (iii.) In a few cases, where the boundary of the sound-area can be drawn as well as the isoseismals, these curves are not concentric. In the Pembroke earthquake of

Nov. 2, 1893, the boundary of the sound-area is approximately of the same form and dimensions as the isoseismal of intensity 4, but it is shifted about 10 or 12 miles to the north-east, *i.e.* in the direction of their longer axes.¹ In the Edinburgh earthquake of Jan. 18, 1889, and the Lancashire earthquake of Feb. 10, 1889, the sound-areas are displaced through a distance of two or three miles towards the fault-line.²

Now, to a person on the surface of the earth, the first vibrations to be observed would generally be those from the nearer lateral margin, then those from the central region (accompanied by vibrations from the upper and lower margins), and, lastly, those from the farther lateral margin, provided they were not too slight to be perceptible. If he were at a great distance from the origin, the only sensible vibrations would of course be those from and near the central region.

Assuming, then, that the sound-vibrations do proceed chiefly, though not entirely, from the margins of the seismic focus, it is evident that the beginning of the sound should nearly always precede that of the shock;³ and the sound should become louder and louder until the shock is felt. At places near the focus, the epochs of maximum intensity of the sound and shock should coincide approximately, and the sound should gradually die away after the shock ceases to be felt. At places more distant from the focus and not far from the longer axis of the disturbed area, the sound-vibrations from the farther lateral margin should first cease to be heard, while those from the margins above and below the central regions have become relatively less perceptible. Thus, as we recede from the origin in the direction of the longer axis, the instant when the sound is loudest should precede that when the shock is strongest; and at considerable distances the sound should, to most observers, die away before the shock.

That there is a lower limit below which sounds and rumbling noises cannot be perceived as such by the ear is evident from many of the observations recorded in the preceding pages. There are numerous cases in which observers equally alert in the same town or village, and several in which observers in the same house, felt the shock, but in which one heard a loud rumbling sound, while another heard no sound at all. I shall refer to this subject more fully in Chapter VIII. For the present, it is sufficient to state that, if the period of the vibrations be comparatively great (say, a large fraction of a second), the amplitude of these vibrations in an ordinary earthquake is insufficient to make them audible. Vibrations can therefore be sensible as sound only to a moderate distance from the focus—a distance varying in

¹ *Quart. Journ. Geol. Soc.* vol. 53, 1897, p. 170.

² *Geol. Mag.* vol. 8, 1891, pp. 64, 311.

³ At and near the point where the normal to the seismic focus through its centre meets the surface, the beginning of the sound should follow, or possibly coincide with, that of the shock, if the slip took place instantaneously.

different earthquakes and for different persons in the same earthquake, —while the larger vibrations of a strong earthquake are perceptible to the body of the observer within limits that may be very much greater. On the other hand, if the fault-displacement were extremely small, the central region would practically not exist; the shock, if felt at all, would be a very feeble one, and the sound would be the only phenomenon observed.

Lastly, since the fault-surface is inclined to the horizon, and since the two lateral margins may be of unequal length, it follows that the boundary of the sound-area should not be concentric with the neighbouring isoseismals. It might be displaced towards the fault-line, if the vibrations from the upper margin predominated; or in the direction of the fault-line, if one lateral margin were longer than the other.

Method of Investigation

In the case of an earthquake produced by fault-slipping, the seismic focus is practically a surface, inclined to the horizon, and as a rule probably of far greater dimensions along the strike, than along the dip, of the fault-surface. With a focus so situated, we might expect that there would be certain peculiarities in the form and relative position of the isoseismal lines that would enable us to discover the direction and hade of the originating fault, and possibly to trace the course of the fault-line within the epicentral district. The object of the present section is to determine what these tests are, and, at the close of the next chapter, their application to the Hereford earthquake will be considered.

In order to simplify the problem, I will suppose the earth's crust to be a homogeneous, isotropic body, and the fault-surface to be plane, and that, at a depth of a few miles, a slip takes place along the fault and thus gives rise to an earthquake. Now, let us consider the effect of the slip at some point on the earth's surface. If a sphere be described with this point as centre, it will intersect the focus in an arc of a circle, and the disturbances from all points on the arc will affect the point simultaneously. If, again, with the same point as centre, another sphere be described whose radius is greater than that of the first by the length of an earth-wave, then the disturbances proceeding from the arc of intersection of the larger sphere will begin to affect the motion of the point on the surface just as the disturbances from the other arc are ceasing to affect it. At that moment, then, the movement of the point is due to the combined effect of the disturbances from that part of the focus enclosed between the two arcs of intersection. If, for simplicity, we suppose the initial displacement all over the focus to be uniform, then, other conditions being the same, the intensity at a given point on the surface of the earth at any moment will be the greater, the larger the surface of intersection made by the

two spheres at that moment. Thus, the point where the intensity is greatest will be situated close to the point where the normal to the focus through its centre meets the surface of the earth. It will not coincide exactly with this point, however, but with one somewhat nearer the fault-line, since the intensity of the disturbance from any point of the focus varies inversely as the square of the distance.

Direction of the Fault.—If the focus were of some length and the initial displacement throughout it uniform, then, on one side of the focus, the intensity would obviously be the same at all points equally distant from the fault-line. The isoseismals would thus be straight lines parallel to the fault-line connected by curved lines near the ends of the focus. The displacement, however, under natural conditions, is not uniform, but is a maximum near the centre and then decreases gradually towards both ends of the focus until it vanishes. In this case, the isoseismals will bulge outwards near the middle and will be contracted towards the ends; i.e. they will assume forms which are roughly those of ovals or ellipses, whose longer axes are approximately parallel to the fault-line. Thus, when the isoseismals are much elongated, the direction of their longer axes gives the direction of the originating fault.

Hade of the Fault.—In Fig. 8, let DE represent a vertical section of the surface of the earth perpendicular to the fault-line, AB the fault,

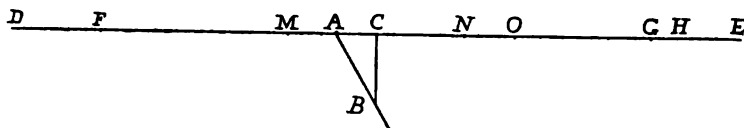


FIG. 8.

B the centre of the focus, and C a point on the surface vertically above B. Let D and E be two points on the surface at equal distances from C. If these distances be very great, the pairs of concentric spheres with D and E as centres will at any moment cut off the same part of the focus, and then the intensities at these points will be the same.

Now, let F be a point near D in DA, and G a point in EA, so that DF and EG are equal, and so also BF and BG. But BF is further inclined from the normal to the focus than BD is, while BG is more nearly inclined to it than BE is; and therefore the intensity at G must be greater than the intensity at F, and the intensity will be equal to that at F at some point, H, inside GE. That is, the distance DF between two distant isoseismals on the upthrow side of the fault is greater than the distance EH between the corresponding isoseismals on the downthrow side.

Next, take a point M in AD not far from the fault-line, and on the other side of it take a point N so that CN and CM are equal.

But, since BN is more nearly normal to the fault-surface than BM, the intensity at N must be much greater than at M. Hence, the intensity will be equal to that at M at some point, O, in NE. But the intensity at A is the same for both upthrow and downthrow sides of the fault.¹ Hence, AO being greater than AM, the distance between two isoseismals near the fault-line on the upthrow side is less than the distance between the same isoseismals on the downthrow side. Thus, the hade of the fault can be determined from the relative positions of the isoseismal lines, which, on the downthrow side, are at first farther apart, and afterwards nearer together, than on the upthrow side.

Position of the Fault.—In most cases, it is difficult to lay down the exact course of the fault-line. Sometimes, but rarely, the method suggested in the last footnote may give a point on the fault-line, and, with the direction known, this is of course sufficient. But, as a general rule, all we can say is that it must lie a short distance from the axis of the inner isoseismal and on the side of it opposite to that towards which the fault hades.

¹ Theoretically, under the assumed conditions, the intensity should be zero along the fault-line, for the earth-waves in the two adjoining rock-masses start in opposite phases of vibration, and should therefore completely interfere along this line. It is needless to say that this is never actually the case in nature; nevertheless, there are approximations towards it.

CHAPTER VI

ISOSEISMAL LINES AND DISTURBED AREA

As already mentioned, the intensity of the shock at any place is determined by reference to the degrees of an arbitrary scale, known as the "Rossi-Forel scale of seismic intensity" (p. 11). If we plot upon a map all the places corresponding to a given degree of intensity (say, 8), and also all the places in the immediate neighbourhood where the intensity is known to have been less than 8, and then draw a curve including all the former places and excluding all the latter, we shall obtain a line at every point of which the intensity was the same and was just equal to the degree 8 of the scale. This is called an "isoseismal line of intensity 8." For brevity, it will frequently be alluded to as the "isoseismal 8."

Form of Isoseismal Lines.—It is assumed above that the observations are very great in number and all of them accurate. As this is a degree of perfection hardly attainable in practice, there is some difference of opinion among seismologists with regard to the exact form which these lines should take. Fig. 10 is given chiefly for another purpose, but it will help to illustrate the method here adopted. At all the places marked by a small disc, the intensity was not less than 8, *i.e.* structural damage occurred to buildings,—chimneys were thrown down or walls were cracked. At those indicated by a cross, some slight damage was done, but there are reasons either for doubting whether the intensity should be reckoned as high as 8 or else for supposing that the buildings were previously unsound. Places where, so far as my informants knew, no damage at all took place, are denoted by small circles.

With the evidence thus before us, how shall we draw the isoseismal 8? One seismologist, trusting chiefly to his positive evidence, would draw the curve as a wavy line (Fig. 9). The only objection that need be urged against this method is that the evidence is far too scanty for such a course. Before we could place the least reliance upon a curve like this, the number of positive observations inside it, and of negative observations outside it, would have to be multiplied many times.

A somewhat less objectionable method is to connect all the more outlying places by straight lines. If this be done in the present case, we shall obtain an irregular polygon, which does not differ essentially from the oval curve in Fig. 10, because the number of determining places is fairly large. It is, however, in the highest degree unlikely that isoseismal lines should ever be straight even for a short distance. The line so obtained must therefore deviate sensibly from a true

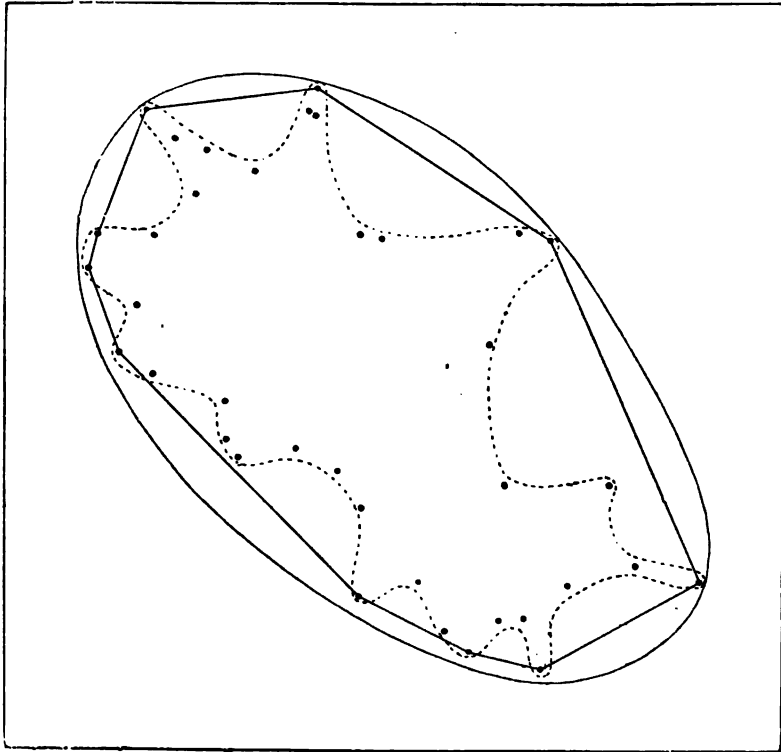


FIG. 9.—Methods of drawing Isoseismal Lines.

isoseismal line, and the error must be greater the smaller the number of observations.

On the other hand, though it is conceivable that an isoseismal line may in parts be convex towards the origin, it is not likely that it should often, except in details, be otherwise than concave. It therefore seems very much more probable that the average course of an isoseismal line should be roughly in the form of an oval or ellipse, surrounding all the places of the given intensity as closely as possible.

To such a curve, the true isoseismal probably bears nearly the same relation which the form of the coast-line of an ordnance map does to that of the contour-lines, or, on a smaller scale, which the undisturbed orbit of a planet would do to the path actually followed in the presence of other bodies.

Isoseismal of Intensity 8.—The isoseismal 8, being the innermost, is the most important of the whole series, and at the same time, fortunately, it is the one that can be drawn with the greatest accuracy, on account of the permanence and definiteness of the test. It contains within it 73 places where marked damage was done to buildings. Of these, 55 are in Herefordshire, 17 in Gloucestershire, and 1 in Worcestershire. Outside the isoseismal, there are numerous places where undoubted damage occurred, but which was clearly insufficient to entitle the intensity at them to be ranked so high as 8. For instance, at Knightwick, which is two miles from the curve, stones fell from the top of a tall and tapering church-spire; at Hay, 8 miles distant, a solitary chimney fell; and this was also the case at Worcester, which is 7 miles from the isoseismal. Again, at Stour-bridge, 23 miles distant, several bricks fell from a chimney, and their fall was observed by a policeman on duty who also felt the shock. Still farther away, examples are reported of damage whose connexion with the earthquake is more or less uncertain; and there are others, such as that of the wall at Hartlepool, whose fall on the day of the earthquake must have been a mere coincidence. At none of these places would it be fair to count the intensity as 8, and all are therefore rejected in drawing the isoseismal.

The curve is an elongated oval, 40 miles long, 23 miles broad, and includes an area of 724 square miles. The longer axis is directed W. 44° N. and E. 44° S., i.e. almost exactly N.W. and S.E.

The amount of damage was comparatively greatest at Hereford, Dinedor, Fownhope, Dormington, and Withington, and next, at Cowarne, Hagley, Much Marcle, and Stoke Edith. With the exception of Cowarne and Much Marcle, these places all lie within the smaller curve on the map (Fig. 10), which is $8\frac{1}{2}$ miles long, $6\frac{1}{2}$ miles broad, and contains 41 square miles. It cannot, I think, be regarded with certainty as an isoseismal line, for the intensity was probably greater on the south-west side, in the neighbourhood of Hereford, Dinedor, and Fownhope, than elsewhere. The centre of the curve is $3\frac{1}{2}$ miles E. 11° S. of Hereford. For the purpose of measuring distances, I shall frequently refer to it afterwards as "the centre"; and, as the curve is a small one and probably not far from the originating fault, it is clear that the error cannot in any case be very great.

Isoseismal of Intensity 7.—The next isoseismal may also, I think, be regarded as fairly accurate. It includes all the places where the shock was strong enough to overthrow ornaments, vases, etc. Outside the curve, but at comparatively short distances from it, there are

several places where this test was apparently satisfied, but the evidence is either uncertain or defective, or the objects were in too unstable a position to afford a fair criterion.

The isoseismal is very nearly an ellipse, whose axes are respectively 80 and 56 miles in length and whose area is 3580 square miles. The longer axis runs from W. 42° N. to E. 42° S. It is therefore very nearly parallel to the axis of the isoseismal 8. The distance between the isoseismals 8 and 7 is $13\frac{1}{2}$ miles on the S.W. side, and 20 miles on the N.E. side.

Isoseismal of Intensity 6.—This is probably the least accurately drawn of all the isoseismal lines. It includes the places where the shock was strong enough to make pictures, etc., swing; but the test was inapplicable in a great many cases, as most observers seem to have slept in darkened rooms. The number of determining points is therefore less in this than in any other case. In the south-west and north-east portions of the curve, the error is probably small, and these are the most important parts for our present purpose, but towards the north-west the error may possibly amount to several miles. Outside the curve as here drawn, there are three isolated places where the intensity seems to have been 6 or probably 6. These are Leek (Staffordshire), Levenshulme (Lancashire), and Deganwy (Carnarvonshire): their respective distances from the isoseismal being 11, 15 and 15 miles.

This curve, which represents in my judgment the most probable position of the isoseismal, is again elliptical, 141 miles long and 116 miles broad, and contains an area of 13,000 square miles. The direction of the longer axis is W. 41° N. and E. 41° S., i.e. very nearly parallel to the axes of the two inner isoseismals. The distance between the isoseismals 7 and 6 is 25 miles on the S.W. side and 34 miles on the N.E. side.

Isoseismal of Intensity 5.—The chief difficulty in drawing the two outer isoseismals is that so large a portion of them, and especially of the isoseismal 4, traverses the sea. In these parts, the paths of the curves are to some extent conjectural. In drawing them, we are guided chiefly by their trend before leaving the land, partly by the known intensity at points along the neighbouring coast-lines.

The isoseismal 5 includes those places where a perceptible displacement was observed, and not merely a tremulous and quivering motion like that produced on a railway-platform by a heavy passing train. Outside the curve, there are seven places where the intensity was apparently as great as 5: Bowden (near Totnes), Plymouth and Torquay (Devonshire), Worthing (Sussex), Bulmer (Essex), and Goole and Howden (Yorkshire). The distances of these places from the isoseismal are respectively $9\frac{1}{2}$, 22, 4, 7, 21, 14 and 16 miles. It is possible that this curve should have been deflected so as to include Bowden and Torquay in the south of Devonshire, but the others are

apparently isolated places, where for some local reason the intensity was greater than in the immediate neighbourhood.

It will be observed that the curve is roughly circular in form; its length from N.W. to S.E. is 233 miles, and its breadth from S.W. to N.E. 229 miles. The area included by it is 41,160 square miles. The distance between the isoseismals 6 and 5 is 60 miles on the S.W. side and 55 miles on the N.E. side.

Isoseismal of Intensity 4.—This curve bounds all the places where the shock was strong enough to make doors, windows, fire-irons or other loose objects rattle. It is still more nearly circular than the isoseismal 5, being 356 miles from N.W. to S.E. and 357 miles from S.W. to N.E. The area it contains is 98,000 square miles. It is interesting to notice that the centre of the small curve surrounding the six or eight places in Herefordshire where the amount of damage was relatively greatest, coincides almost exactly with that of the isoseismal 4. The distance between the isoseismals 5 and 4 is 77 miles on the S.W. side and 51 miles on the N.E. side.

Disturbed Area.—The earthquake was certainly felt at three places outside the isoseismal 4—at the Point of Ayre Lighthouse (Isle of Man), $1\frac{1}{2}$ miles from the curve; at Flamborough Head Lighthouse, 7 miles; and at Middlesborough, $12\frac{1}{2}$ miles distant. I have also received records from several other places—Acklington (Northumberland), 59 miles from the isoseismal; Belfast, 44 miles; Killeshandra (Co. Cavan), 65 miles; Drumcondra (Co. Meath), 29 miles; and Graigue (Co. Kilkenny), 5 miles. It is difficult, on account of the isolated positions of the first four of these places, to determine whether the disturbances observed at them were really due to the Hereford earthquake. The intensity at all of them was what we should expect it to have been. For Drumcondra, no time is given; but, considering the difficulty of obtaining accurate time in villages and small towns, the recorded times at Acklington, Graigue, and Killeshandra are not greatly in error. With regard to Belfast, however, the time given (between 4 and 5, Dublin time) seems to render the observation a somewhat doubtful one.

If we consider the boundary of the disturbed area to have been a circle concentric with the isoseismal 4 and passing through Middlesborough, its area would be 115,000 square miles. If it passed through Killeshandra, the disturbed area would then contain 185,000 square miles, and a not inconsiderable part of it would lie within the north of France.

I am aware that estimates so rough as these cannot possess much value, but at the same time I do not think that they are excessive. The mean distance between the isoseismals 5 and 4 is about 63 miles, and we may fairly suppose that the distance between the latter isoseismal and the boundary of the disturbed area was not much less than this. To sum up, I think we may conclude that the disturbed

area contained not less than 98,000 square miles, probably 115,000 square miles, and possibly as much as 185,000 square miles.

Comparison with other British Earthquakes.—It may be interesting at this stage to compare the intensity of the Hereford earthquake with that of other shocks which have recently been felt in this country.

The Essex earthquake of April 22, 1884, is the one perhaps best known to the present generation, as it was the chief means of converting it from the belief in the absence or comparative harmlessness of British earthquakes. In Colchester and 24 other parishes, no less than 1213 buildings had to be repaired, 414 in Colchester, 207 in East Donyland, and 259 in Wivenhoe and Elmstead. The total number of towns and villages in which damage to buildings occurred was 38, the isoseismal bounding these contained about 335 square miles, and the total disturbed area was about 50,000 square miles.¹ Thus in concentrated severity the Essex earthquake far exceeded the Hereford earthquake, and, if we regard intensity at the surface as the determining factor, this entitles it to be reckoned as the strongest British earthquake of the present century.² But in the number of damaged towns and villages, in the area of structural damage, and in total disturbed area, it was distinctly inferior to the earthquake of 1896. Indeed, in disturbed area, the Essex earthquake has been surpassed by two more recent, but less severe shocks. In the Pembroke earthquake of Aug. 18, 1892, the area included within the isoseismal 4 was 44,860 square miles, and the disturbed area must have been much greater; in that of Nov. 2, 1893, the area within the isoseismal 4 was 35,900 square miles and the disturbed area 63,600 square miles.³ Probably the earthquake which resembles the Hereford earthquake most closely is that which originated in nearly the same district on Oct. 6, 1863. The shock "was felt throughout Wales and the central counties of England, extending north as far as Doncaster, Huddersfield, and Clitheroe; east to Market Rasen, Peterborough, and Bedford; south to London, Dorchester, and Plymouth; and in the west crossing St. George's Channel to Dublin and Wexford." It was, however, perceptible at several isolated places beyond these limits, such as Lancaster, Ulverston, Harrogate, Malton, Scarborough, Bury St. Edmunds, Brighton, and the Isle of Wight.⁴ In intensity and disturbed area, it was evidently only a little inferior to the earthquake of 1896.

¹ R. Meldola and W. White, *Report on the East Anglian Earthquake of April 22nd, 1884* (Macmillan, 1885), pp. 22, 44. For the estimate of the area within the isoseismal 8, I am, however, responsible.

² It might fairly be contended that intensity at the surface is not the decisive test, but rather the total energy within the seismic focus. Taking then into account the fact that, at two neighbouring places, the intensity during a given earthquake is greater on soft than on hard rock, it is open to question whether the Essex earthquake should not resign the premier place to the Hereford earthquake.

³ *Quart. Journ. Geol. Soc.* vol. 53, 1897, pp. 160, 169.

⁴ E. J. Lowe, "History of the Earthquake of 1863, October 6th," *Brit. Meteor. Soc. Proc.* vol. 2, 1865, pp. 55-99.

Among the British earthquakes of the present century, we may therefore claim for the recent Hereford earthquake the second place as regards the amount of damage inflicted on buildings, and the first as regards the area over which it was distinctly perceptible.

Position of the Originating Fault

The relations between the isoseismal lines, as regards their position and dimensions, may be summed up as follows:—

(1) The longer axes of the three elongated isoseismals are approximately parallel to one another, their directions lying between W. 41° N. and E. 41° S. and W. 44° N. and E. 44° S.

(2) As the distance of the isoseismals from the epicentre increases, they become more nearly circular in form. The ratios of the lengths of the longer and shorter axes of the five isoseismals (8 to 4) are, respectively, 1.74, 1.43, 1.22, 1.02, and 1.00. The isoseismal 4 is very nearly concentric with the small curve surrounding the places where the damage to buildings was greatest.

(3) The distance between consecutive isoseismals is at first less on the S.W. than on the N.E. side, and afterwards greater. The ratios of the S.W. to the N.E. distances for the four pairs of isoseismals (8-7 to 5-4) are, respectively, 0.66, 0.74, 1.09, and 1.51.

The conclusions to be drawn from these relations will be obvious from the discussion at the close of the last chapter. They are as follows:—

(1) The direction of the originating fault is almost exactly N.W. and S.E., if anything, a degree or two W. of N.W. and E. of S.E.

(2) The hade of the fault is to the N.E.

(3) The fault-line must be a short distance to the S.W. of the longer axis of the isoseismal 8. The exact position is uncertain. It may lie as far to the N.E. as the line joining Hereford and Fownhope, or as far to the S.W. as that joining Eaton Bishop, Ross, and Mitcheldean. Judging from the relatively low intensity at Bullinghope, Credenhill, St. Michael's Cathedral Priory, Swainshill, and White Cross, the most probable position of the fault-line is about half-way between these two lines, that is, passing through a point about one mile S.W. of Hereford.

CHAPTER VII

NATURE OF THE SHOCK

FULL accounts of the nature of the shock will be found in Chapter II., though in a somewhat tabular form, in the answers to question 4. As these, however, require rather careful study in order to appreciate them thoroughly, and also frequent reference to the answers to other questions, I give first a few detailed descriptions of the earthquake from the epicentral district. These are followed by a general summary of the observations from different parts of the disturbed area, especially of those made on the double series of vibrations; my object here being to discover what evidence the nature of the shock will furnish with regard to the origin of the earthquake. Certain other miscellaneous phenomena, not bearing directly on this problem, will be referred to in a later chapter.

Nature of the Shock in the Epicentral District

The following accounts are from places situated close to the epicentre. St. Michael's Cathedral Priory is $2\frac{1}{4}$ miles W. by S. of Hereford, White Cross 1 mile W., and Cowarne Court about 8 miles N.E., of Hereford.

St. Michael's Cathedral Priory.—“The Priory is situated on rising ground, which falls away on the W., N., and N.E. towards the River Wye. The subsoil is stiff boulder-clay, with rock here and there near the surface. The Cathedral is solidly built throughout and rests on a firm foundation. It is 140 feet long in the direction W. by S. and E. by N. and 50 feet or more in breadth. The roof of both nave and choir is nearly 70 feet from the ground and has very heavy horizontal beams of oak.” The Rev. Canon E. Hilary Willson, O.S.B., to whom I am indebted for this account, and twenty-five other observers were seated in the stalls of the Cathedral Choir, occupied in chanting Matins. “One of our number,” he says, “believes that there was a slight tremulous motion before the principal vibrations and that it lasted 3 or 4 seconds, an estimate which he gives also as the duration

of the preliminary sound. Then a frightful shock seemed to strike the Church at its very foundation, and to shake and literally to bump us up and down five or six times, the last oscillation being the strongest of all. This shaking was accompanied by what seemed to be a shivering of every wall of the Church and by a tearing sound in the walls, a rattling and violent shaking of every window, and a wrenching and creaking of every timber in the roof. Two, who looked up at once, say they distinctly saw the timbers twist from E. towards N. The shaking and shivering movement certainly increased to a maximum and then ceased suddenly, so far as we could tell under our circumstances. I am inclined to think, with at least one other, that there were two shocks, or at least a momentary check and then, after perhaps a second's interval, a rapid development to the maximum. The duration of the shock seemed to me at most two seconds and perhaps less, though some think it was three, four, or even five. The stalls on which we sat and the floor below us of boards seemed to oscillate. A heavy lamp hangs from the ceiling by a chain 50 or more feet long. Some looked at once and said it did not swing or vibrate in the least, though others thought they saw the roof from which it hangs twist. There are many pinnacles and finials to the side altars and candlesticks on each. Some were rather loose before, but not one was moved or fell, and throughout the whole Monastery and Church the only things that fell were a globe, already broken, and minute particles of plaster. This, I suppose, was due to the solidity of the building and its good foundation, and possibly points to a vertical rather than sideway motion. The shock was preceded for two, or at most three, seconds by a sound compared by some to a storm or hurricane rushing from a distance, by others to a moaning, which passed into a thundering, sound, as of an explosion, at the first moment of the shock, and grew louder and louder until the maximum of the shock, when it seemed to cease quite suddenly, though it may have been lost to us in the sounds of effect, if it gradually died away."

White Cross.—Mr. W. Merewether was lying awake in a first-floor room in a house at the south end of a terrace of six houses running nearly north and south, and writes as follows:—“(1) The first noise I heard was a very heavy thud, as of an explosion. It sounded as though behind me [*i.e.* from the N.]. (2) After a perfectly quiet interval of about 5 seconds, there came a succession of violent throbs, with a peculiar muffled sound and rattling of the window. At the same time, there was a very peculiar sound which I can only liken to the noise I have heard when rushing through a station in an express train; this ceased as suddenly as the other does when the train has cleared the station. (3) Up to this time, I had felt no motion of the bed, though possibly the noises may have so absorbed my attention that I was unconscious of any; but, as the window was finishing its rattle, I felt the bed shake. It was as though strong hands on the

right or north side of the bed had seized it by the middle and shaken it across two or three times, in about three or four seconds. (4) After an interval of, say, five seconds, this shock was repeated with less violence, lasting about two seconds, but no noise accompanied it. (5) I thought I felt a third shock, still weaker and only momentary. . . . The impression the whole left on my mind was that there was more noise than shake. When, on coming downstairs, a couple of hours later, I carefully examined the house, I found nothing to show that anything had moved. Light ornaments and vases on mantelpieces and on brackets, placed here and there against the walls, had not in a single instance moved in the slightest degree."

Cowarne Court.—"I was awakened," says Mr. H. B. Dugmore, "by low rumbling noise and slight vibration. This gradually increased till everything in the room trembled and then a general heaving began, a wardrobe door flew open, and the walls (stone) made a crushing noise on every side, and the timbers of floor and ceiling creaked. This slower motion was immediately succeeded by 4 or 5 . . . distinct waves from S. by W. to N. by E., which I can only describe by the sensation of crossing the wake of a steamer in a very short rowing-boat. To any one who is conversant with this, the illustration will pretty accurately describe the sort of motion, as the waves were steeper and shorter than in an ordinary sea. The only other illustration which conveys the feeling is that of being in the brake-carriage of a railway train (which has not got a continuous brake), which, when the brake is applied, moves forward with a succession of bounds. With the last of these waves, all noise and vibration quickly died away. . . . I should think the whole thing occupied from 15 to 20 seconds, but when only just awakened from sleep it is difficult to speak very accurately. . . . I can find no outward sign of damage to this house, but a good many cottages in the immediate neighbourhood had their chimneys either partially or wholly overturned, in some cases they fell through the roof and the inmates very narrowly escaped."

Variation in the Nature of the Shock throughout the Disturbed Area

Variations in the nature of the shock may be due to the mere size of the focus, to its elongated form or inclination to the horizon, to the fact that the slipping over the whole focus may have been progressive and not instantaneous, and also to the distance of the place of observation from the epicentre. I propose to summarise the evidence very briefly with regard to three of these points, reserving for the next section the discussion of the double series of vibrations.

Variations due to the Size of the Focus.—The effect of the size of the focus is chiefly manifested as rapid changes in the direction of the movement at places near the epicentre. At a considerable distance,

the focus subtends so small an angle that the changes of direction due to its size must be imperceptible. At Hereford, according to one observer, the disturbance consisted of waves proceeding from two or three directions. About a mile east of Hereford, at Hampton Green, there was an uplifting motion terminating in a violent horizontal shock. At Walford, near Ross, an observer was awakened by his bed being violently shaken north and south two or three times, followed by an east and west movement. At Myth Hill, near Tewkesbury, the shock began with an undulatory movement like a swell at sea, after which there was a violent upward movement, apparently quite vertical, followed by a deep drop and another upward movement not quite so violent; for the next second or less, the house twisted S. towards W., during which time beams cracked like pistol-shots; and it then seemed twisted back by the next wave; the shock ending with a simple wave-movement, like that felt at first, for about two seconds.

Variations due to the Form and Position of the Focus.—Of the following places, the first three lie some distance to the south-east of the focus. At Oaklands, near Chard, a shivering motion was first felt, and then, after about three or four seconds, the bed distinctly rocked from side to side. At Exeter there was a sudden tremor of the bed, which lasted about two seconds, and then, after two or three seconds, there was another and more severe shaking lasting four or five seconds. At Rothamsted, near Harpenden, two shocks were noticed; the first a shaking as if a heavy vehicle were passing close; the second, a few seconds afterwards, consisted of undulatory shakes, followed by a distinct upheaval.

The next five places lie to the north-west of the focus. At Meifod the shock was in two distinct parts, the first a rocking motion, the second a trembling. At West Cross, near Swansea, there was a wavy side-to-side movement for about four seconds, followed soon after by a tremulous shock. At Liverpool there were two distinct shocks; the first lasted about six seconds, and then, after a pause of two seconds, a less intense vibration for about four seconds. At Douglas, in the Isle of Man, an observer was aroused from sleep by a shaking of the bed, as if he were being riddled with a riddle, and, after lying down again, there was a slight vibration. At Glenealy, in Co. Wicklow, the bed of one observer was considerably shaken, and in an instant or so after another slight trembling was felt.

Variation with the Distance from the Epicentre.—The principal effect of increasing distance from the epicentre is of course the suppression of the weaker vibrations; so that, near the boundary of the disturbed area, the stronger of the two series of vibrations was as a rule the only one observed. But, besides this natural effect, the period of the vibrations also increases with the distance.

Close to the epicentre, the general impression was that of crossing

the wake of a steamer in a very short rowing-boat, or of riding in a carriage without springs. At Moorhampton, which is 8 miles W.N.W. of Hereford, the vibrations were so fierce and quick that they resembled the beats of an engine going at fifty miles an hour. Farther away, at distances of about 90 or 100 miles, the movement was of a pleasant, gentle, undulating character, more like that felt during the rocking of a ship at anchor or in a carriage provided with springs. "The movement was regular and well defined," says an observer at Aigburth, near Liverpool, "the sensation, not an unpleasant one, was of the soft undulating character experienced in a coach with well-appointed springs." At Lea Hurst, near Matlock Bath, gentle, long, swaying movements were felt, like a ground swell at sea.

Double Series of Vibrations

It will be obvious, even from the accounts given in this chapter, that the shock was not continuous. At many places it consisted of two distinct parts separated by a few seconds. These two parts differed as a rule in intensity, in duration, and in their character; one part consisting of large oscillations of comparatively long period which gave rise to the rocking or rolling motion; the other of vibrations of smaller amplitude and shorter period, producing what many observers describe as a tremulous or quivering sensation.

Character of the Observations.—The only observations which are thoroughly reliable are those made by persons who were awake at the beginning of the shock. Next to those are the observations of persons who were asleep at the commencement, and who awoke in time to feel the first series stronger or longer than the second. But it is evident that the observations of those in the same condition who estimated the second series stronger or longer than the first cannot be depended on, though they are not necessarily incorrect, for the observers may have slept through the principal part of the first series of vibrations. I have, therefore, made no use of observations belonging to this last class in the discussion of the relative intensity and duration of the two series.

It will be seen that, as regards these points, and especially as regards the relative intensity, the evidence is varied and contradictory. A good deal of this conflict is due to the uncertainty as to what constituted the two series. Some observers note the existence of three series, and, strictly speaking, this is no doubt true, for, according to my own experience, there certainly was a very brief break in the middle of the second series. Others, again, seem to have confused one of the minor shocks before or after the principal shock with one of the twin series of vibrations, improbable as this may appear at first sight. But the chief source of the errors is I believe due to

defective observation and memory. The phenomenon is unexpected and of comparatively short duration; observers rarely make any note of their impressions, and, when they do, are often ignorant of the features to be noted. After the lapse of several days or weeks, they are asked to record observations upon which they bestowed but little

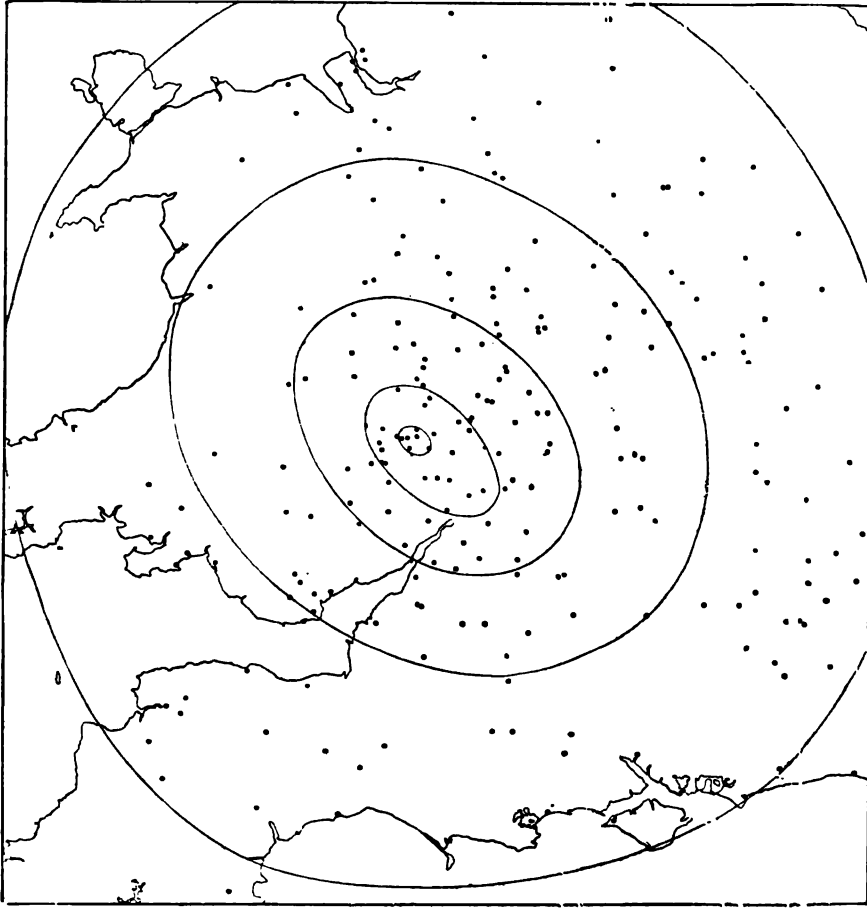


FIG. 11.—Map showing the Distribution of the Places where the Double Series of Vibrations was observed.

attention at the time. It is not surprising, then, that on a delicate point like this there should arise some discrepancy in the accounts.

Number of Observations and Distribution of Places of Observation.—While allowing that, on account of the sources of error pointed out above, many of the observations on the double shock may be faulty,

the number of such observations is large, considering how many observers were awakened by the shock. The total number is 265.

Some of these records come from great distances, and this is especially the case on the north-west side of the minor axis of the isoseismals. It will be seen afterwards that on this side of the axis, the first of the two series was the stronger and therefore roused the attention of observers for the slighter movement to follow. The double shock was noticed in Pembrokeshire and Westmoreland, and even in the Isle of Man and in Ireland. The distribution of the places of observation within a large central area is shown in Fig. 11. The places are here seen to occur practically over the whole district, though, as will be shown afterwards, there exists a band within which the two series were approximately superposed and appear as a single series.

Relative Intensity of the Two Series.—Observations on the relative intensity of the two series were made at 144 places, i.e. at a little more than half of the places where the double series was recorded. At 59 of these places the observers were awake, at 43 asleep, and at the remaining 42 the observers were doubtful whether they were awake or asleep at the beginning of the shock, or else there is no information on this point. The majority of the 59 places where the observers were awake are shown in Fig. 12, which represents the same district as the preceding figure. The small discs indicate places where the first series appeared the stronger, the circles those where the second series was stronger.

It will be seen at once from this figure that both signs occur on each side of the minor axis of the isoseismals. They are not, however, equally numerous. At the majority of places on the north-west side of the minor axis, the first series is recorded as the stronger, and on the south-east side the second series. Moreover, the discrepancies are slightly less serious if we regard the boundary between the two districts, not as a straight line coincident with the minor axis, but as a curved line slightly concave towards the south-east. I may add, too, that by far the larger number of places where observers, who were asleep or not known to have been awake, regarded the first series as the stronger, lie in the north-west district.

Relative Duration of the Two Series.—Records of the relative duration of the two series were made at only 21 places by observers who were awake when the shock occurred. At all four places in the north-west district, the first series was longer than the second; and at four places close to the minor axis, this was also the case. In the south-east district, the second series is recorded as longer than the first at five places, but two of the remaining four places lie on the north-west side of the curved line mentioned in the last paragraph.

Relative Nature of the Two Series.—In the present case, I have considered the evidence of all observers, whether asleep or awake at

the time when the shock occurred. This is clearly a matter of less consequence, when one series is described as consisting of long-period, and the other of short-period vibrations. Even with this admission, however, there are observations from no more than 27 places.

In the north-west district, the first series is said to have consisted

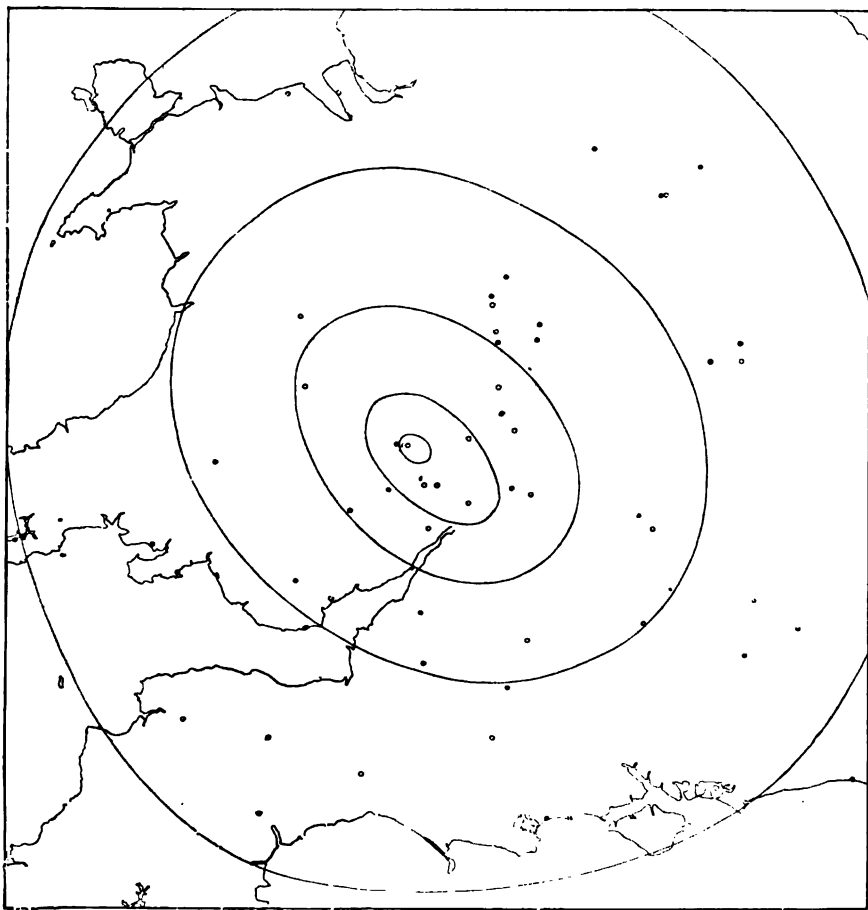


FIG. 12.—Map illustrating the Relative Intensity of the two Series of Vibrations.

of long-period vibrations at five places and the second at one ; close to the minor axis, the first series at four places and the second at two ; and in the south-east district, the first series at two places and the second at thirteen.

Thus, the discussions of the relative intensity, duration and nature

of the two series lead to similar conclusions. In the north-west district, the first series is generally stated to be of greater intensity and duration and of longer-period vibrations than the second series; in the south-east district, the second series takes the place of the first. Moreover, the boundary between the two districts appears to be, not straight, but, rather, a curved line slightly concave towards the south-east.

It will be noticed also that the evidence with regard to the relative duration and nature of the two series is far less contradictory than that with regard to their relative intensity. And this, I think, is important; for to estimate the relative duration of the two series or to observe their relative nature requires a closer attention to the earthquake during its progress than to estimate the relative intensity. The evidence of the more careful observers, therefore, approaches most nearly to unanimity.

Origin of the Double Series of Vibrations.—A double series of vibrations may be due to: (1) a single initial impulse and subsequent reflexion or refraction of the earth-wave at the bounding surfaces of different rock-formations; (2) a single initial impulse and two earth-waves, the first consisting of longitudinal, and the second of transversal, vibrations; (3) a repetition of the originating impulse at the same place; (4) simultaneous impulses at two detached, or nearly detached, portions of the focus; or (5) successive impulses at two detached, or nearly detached, portions of the focus.

(1) The first theory seems out of the question on account of the wide distribution of the places where the double series was observed and the different character of the vibrations of the two series. (2) The second explanation is at first sight a more plausible one, for we should then expect the vibrations of the two series to differ, but the fact that the long-period vibrations are generally recorded as occurring first in the north-west district and second in the south-east district is opposed to its acceptance. Moreover, if it were true, the interval between the two series should be very small near the origin and should increase with the distance from the epicentre. Now, though individual estimates of duration are not often to be trusted numerically, there is no ground whatever for supposing that the interval between the two series increases as it should do with the distance. The same phrases are used to express the interval all over the disturbed area; estimates of two or three seconds are as common at distances of 80 or 100 miles from the centre as they are in Herefordshire and the surrounding counties.¹ (3) If the double series were

¹ If each series gradually increased in intensity and then died away, there should of course be a slight progressive increase in the interval with the distance, owing to the gradual extinction of the weaker vibrations at the end of the first series and beginning of the second. To this is probably due the slight increase in the average recorded duration of the interval, which in the central counties (see p. 237) is 3·4 seconds, in the inner ring 3·3 seconds, and in the outer ring 4·1 seconds.

due to a repetition of the impulse at the same focus, the relative intensity, duration and character of the two series would be the same throughout the whole disturbed area.

(4, 5) Since, then, the double series cannot be due to a single or repeated impulse at the same place, we must infer that the focus consisted of two nearly, or quite, detached portions, and we are left to decide between the fourth and fifth theories, whether the two impulses were simultaneous or whether the impulse at one part of the focus succeeded that at the other part, and, if so, which occurred first. In both cases, it is evident that the interval between the two series should be greatest in the line joining the two parts, *i.e.* along the longer axis of the isoseismals. If the impulses were simultaneous, the interval between the two series should be zero along and near the minor axis; but, if the impulses were not simultaneous, the interval should be zero along a hyperbolic line concave towards the focus where the impulse occurred latest. The form of the hyperbola would of course depend on the interval between the impulses, nearly straight if the interval were very small, and gradually closing up with the increase of the interval, until it became two coincident straight lines when the interval between the impulses became equal to the time required for the earth-wave to traverse the distance between the two foci. If the interval between the impulses were greater than this, then the relative intensity, duration and character of the two series would be the same throughout the disturbed area. From the evidence already adduced on these points, we may therefore conclude that the focus consisted of two portions situated along a north-west and south-east line, and that the impulse at the north-west focus preceded that at the south-east focus by a very short interval of time, probably not much more than two or three seconds.

There remains, however, an important point to be examined. We have seen that the boundary between the north-west and south-east districts must be slightly concave towards the south-east; but, in order to complete the evidence, we ought to be able to show that along this boundary the interval between the two series was zero. Owing, however, to the fact that each focus must have been several miles in length (for the duration of each series amounted to several seconds), the two series must coalesce and form one series rather along a band than along a line, though, near the boundary of this band, a careful observer should be able to distinguish two maxima with continuous vibrations between them.

We should hardly, indeed, be led to suspect the existence of such a hyperbolic band from Fig. 11. I have therefore examined independently all the records made by observers who were awake before the shock and who specially noted that only one series was perceived. These records come from 49 places. A few of them are scattered indiscriminately over the disturbed area, and show no signs of concen-

tration, but the majority lie within or very near a band whose boundaries appear to be roughly hyperbolas concave towards the south-east and coaxial with the isoseismal 8. Within 20 or 30 miles of this axis, the places are grouped rather closely, but farther away they occur more sparsely; and, on this account, I do not think I should be justified in transferring the hyperbolic boundaries to the map of the earthquake. The curvilinear axis of the band is, however, represented—approximately, no doubt, but at the same time, I think, without any very serious error.

Interval between the Two Series of Vibrations.—According to nearly all the observers who distinguished the two series of vibrations, there seems to have intervened a period of a few seconds of absolute rest and quiet. The length of the interval must of course have depended on the position of the observers, vanishing within the hyperbolic band, owing to the superposition of the two series. As the mean duration of the shock was about 9·3 seconds, we may obviously exclude all estimates of the length of the interval which are above 10 seconds. There remain 72 records, and these give 3·6 seconds for its average duration.

At 13 places two maxima of intensity were detected, with a continuous movement between them, but these as a rule are closely connected with the hyperbolic band. Cleeve Prior (near Evesham), Droitwich, Oldbury Grange (near Worcester), Stoke Works (near Bromsgrove), and Llandaff probably lie within the band; Bristol, Goodmoor Grange (near Bewdley), Stourbridge, and Llantwit Vardre (near Pontypridd) are within a few miles of its boundaries; Compton (near Wolverhampton) and Pyle (near Bridgend) at moderate distances; but Berwick St. John (near Shaftesbury) and Goldenhill (Staffordshire) are too far away to come under this heading. In most cases, therefore, the intermediate movement is clearly due to the superposition or succession of the final tremors of the first series and the initial tremors of the second.

Duration of the Shock

The estimates of the duration of the shock are too discordant to be of much value. If we confine ourselves to those made by observers who had been awake for some time previously, we find that in Herefordshire alone they vary from 2 to 30 seconds. In a few cases, in other counties, they rise to two, and once even to three, minutes. If we exclude obvious exaggerations such as these, indeed all estimates above 40 seconds, the discrepancies are still considerable; and, the number of observations not being very great, the higher figures interfere with the averages for each county, so that they do not vary continuously from one county to another. The construction of curves of equal duration thus becomes impossible.

One reason for the discordant estimates has been already pointed out (p. 11), namely, the natural tendency to exaggerate the duration of a sudden and unexpected phenomenon. On the other hand, many of the estimates obviously refer only to the stronger of the two series of vibrations, and may therefore be rather under than above the true value.

Table II. gives the average duration of the shock for each county, the calculations being made only from the estimates of those who were awake at the time.

TABLE II
AVERAGE DURATION OF SHOCK

County.	No. of Obs.	Average Duration in Secs.	County.	No. of Obs.	Average Duration in Secs.
Hereford . . .	31	9·8	Devon . . .	10	9·5
Gloucester . . .	29	11·0	Hampshire . . .	4	5·7
Worcester . . .	37	10·6	Surrey . . .	5	5·6
Shropshire . . .	16	10·8	London . . .	11	5·0
Radnor . . .	6	9·5	Middlesex . . .	4	5·6
Brecon . . .	11	9·0	Hertford . . .	5	11·4
Monmouth . . .	14	10·4	Cambridge . . .	5	4·7
Somerset . . .	11	12·4	Northampton . . .	6	12·9
Wiltshire . . .	11	9·1	Leicester . . .	6	7·2
Berkshire . . .	7	6·9	Lincoln . . .	3	6·3
Oxford . . .	7	6·8	Nottingham . . .	7	10·7
Warwick . . .	11	12·0	Derby . . .	9	9·4
Birmingham . . .	13	7·2	York . . .	13	4·9
Stafford . . .	13	8·9	Lancashire . . .	17	9·2
Cheshire . . .	11	7·0	Carnarvon . . .	7	2·5
Flint . . .	3	8·0	Merioneth . . .	4	5·6
Montgomery . . .	11	11·5	Carmarthen . . .	5	6·9
Glamorgan . . .	9	10·7			

Several counties, in which only one or two estimates of the duration are made, are omitted from the above Table. Including these, the average of all the 390 records is 9·3 seconds.

Whenever a shock begins and ends gradually, the weaker terminal vibrations are imperceptible at a considerable distance, and thus the average duration of the shock should decrease as the distance from the centre increases. In most cases, this is evident from the Table. The effect of distance is, however, best illustrated by dividing the whole disturbed area into districts, the first including the central counties, from Hereford to Monmouth; the second an inner ring of

counties, from Somerset to Glamorgan; and the third an outer ring, including all the remaining counties. In the central counties the average duration is 10·6 seconds, in the inner ring 9·5 seconds, and in the outer ring 7·7 seconds.

Approximate Position and Dimensions of the Two Foci

The isolation of the two series of vibrations at places outside the hyperbolic band shows that the two portions of the focus were entirely detached. It is, of course, possible that they were so far separated as to be connected with two distinct, but neighbouring, faults having approximately the same direction and hade; and, from the evidence of the principal shock alone, I think it would be difficult to disprove such a supposition if the two faults were very close to one another. It is not, however, a probable theory; and, as will be seen, the evidence of the preliminary shock, which occurred at about 3 A.M., is opposed to it. The focus of this shock appears to have embraced not only the two foci of the principal earthquake, but the intermediate space as well. While admitting, then, that the proof is not complete, it seems to me reasonable to conclude that the two foci of the principal shock were portions of one and the same fault.

It is not possible to do more than estimate roughly the positions of the two foci.¹ There can be little doubt, I think, that the north-west, or more important, focus lies in the immediate neighbourhood of Hereford; and, in fixing its centre at about three miles south-east of that city, we cannot be far wrong. Nor can we err greatly in assuming the centre of the other focus to be similarly placed with respect to the south-east portion of the isoseismal 8, say, about two or three miles north-east of Ross. Such a position would accord with the evidence of the curvilinear axis of the hyperbolic band, and fairly also with the estimates of the average duration. The distance between the centres of the two foci would therefore be about eight or nine miles.

The mean surface-velocity of the earth-wave being about 3000 feet per second,² and the mean duration of the quiet interval between the two series being about 3·6 seconds, the nearest extremities of the two foci must have been separated by a distance of not less than two miles. The estimates of the duration of the two series can seldom be trusted implicitly, but the duration of the series from the north-west or Hereford focus generally exceeded that of the series from the south-east or Ross focus by a few seconds. Thus, the length of the Hereford focus

¹ Theoretically, the form of the hyperbolic band should enable us to calculate the positions of the two foci, but its course cannot be laid down with sufficient accuracy for this purpose.

² See Chapter X.

must have been greater than that of the Ross focus by about a couple of miles, and we may therefore estimate the lengths of the two foci at about 8 and 6 miles respectively. Including the undisturbed intermediate portion, the total length of the focus must have been about 16 miles, a result which seems probable, so far as we can judge from the dimensions of the isoseismal 8.

CHAPTER VIII

SOUND-PHENOMENA

A LARGE number of the records of the earthquake are merely statements of its perception at distant places or determinations of its intensity. Those which enter into greater detail are 2681 in number, and of these 622 make no reference to earthquake-sounds. Of the remaining observers, no fewer than 1589 heard the sound, while 470 distinctly state that it passed unheard by them. In other words, out of every five observers, three at least were auditors of the sound.

The proportion of those who were unconscious of any sound, namely, 17·6 per cent, is certainly rather large. It cannot, to any appreciable extent, be attributed to the condition of the observers at the time of the earthquake, for, omitting those who make no reference to the sound, 25·0 per cent of those who were awake, and 26·0 per cent of those who were asleep, heard no noise. Nor can the defect be entirely, or even largely, due to the sound being drowned by other noises, though this is an explanation often given and accepted by seismologists; for in Herefordshire and the six surrounding counties, where the rattling of windows, etc., would rather be effaced by the earthquake-sounds, 16·3 per cent of all the observers, and 7·7 per cent of those who were awake, perceived no sound. It is thus clear that the defect was due, not to want of alertness or other accidental conditions, but rather, as will be urged more fully below, to the deafness of these observers for those particular sounds.

In the following Table are given for each county the numbers of observers who heard the sound, heard no sound, or make no reference to it or are otherwise uncertain. The experiences of those who were awake, asleep, or in a doubtful condition, are separated. The last column shows the percentage of all the observers who heard the sound.

TABLE III

NUMBER OF OBSERVERS WHO HEARD, OR DID NOT HEAR,
THE EARTHQUAKE-SOUND

County.	Awake.			Asleep.			Doubtful.			Percentage of all observers who heard the sound.
	Heard sound.	Heard no sound.	Doubtful.	Heard sound.	Heard no sound.	Doubtful.	Heard sound.	Heard no sound.	Doubtful.	
Hereford	49	1	2	67	4	8	40	1	7	87·2
Gloucester	46	6	5	70	7	12	59	4	18	76·5
Worcester	55	5	3	43	10	13	59	1	11	78·5
Shropshire	18	1	4	28	6	12	43	3	10	70·2
Radnor	9	...	...	10	1	1	10	3	3	78·4
Brecon	7	1	2	8	1	...	7	1	...	81·5
Monmouth	19	3	...	22	3	11	26	2	3	75·3
Somerset	11	4	4	12	8	5	24	3	15	54·7
Wiltshire	10	2	1	12	8	6	19	6	6	58·6
Berkshire	5	6	4	10	6	11	10	2	3	43·9
Oxford	6	2	2	3	3	6	18	3	10	50·9
Warwick	13	7	7	13	7	10	21	5	5	53·4
Birmingham	19	4	5	28	13	16	24	5	1	61·7
Stafford	15	7	3	12	5	6	18	8	17	49·4
Cheshire	7	6	4	7	6	5	15	6	12	42·6
Flint	4	2	...	4	1	2	4	...	2	63·2
Denbigh	2	...	2	4	2	1	8	1	4	58·3
Montgomery	12	2	1	7	3	2	11	1	7	65·2
Glamorgan	12	4	7	10	6	4	19	4	12	52·6
Cornwall . . . . .	...	...	2	...	1	...	2	...	1	33·3
Devon	10	7	2	11	2	6	19	14	1	55·6
Dorset	2	1	2	4	4	2	7	1	3	50·0
Hampshire	5	4	1	5	4	2	7	5	2	48·6
Isle of Wight . . . . .	...	1	...	...	...	...	1	...	2	...
Sussex . . . . .	...	...	1	2	1	1	2	...	1	...
Surrey	5	7	1	7	4	6	9	7	8	38·9
Kent	1	1	1	...	...	1	...	3	1	...
London	10	8	15	8	12	6	5	8	8	28·7
Middlesex	2	2	2	4	5	4	3	1	1	37·5
Hertford	5	5	3	4	2	11	9	3	8	36·0
Bedford	1	1	...	2	2	2	6	1	2	52·9
Buckingham	1	...	1	8	4	5	15	3	10	51·1
Huntingdon	1	2	...	2	...	...	2	...	1	...
Cambridge	1	3	1	...	1	...	3	1	...	40·0
Essex	1	1	1	1	2	2	1	1	3	23·1
Suffolk . . . . .	...	...	...	1	...	1	...	1	...	...
Norfolk	1	2	...	1	...	...	...	...	...	...
Northampton	8	2	...	4	1	4	16	2	7	63·6
Leicester	9	2	3	9	1	3	15	6	6	61·1

TABLE III—*Continued*

County.	Awake.			Asleep.			Doubtful.			Percentage of all observers who heard the sound.	
	Heard sound.	Heard no sound.	Doubtful.	Heard sound.	Heard no sound.	Doubtful.	Heard sound.	Heard no sound.	Doubtful.		
Rutland	2	1	1	3	1	2	60·0
Lincoln	2	1	2	4	2	3	3	7	1	1	56·5
Nottingham	8	4	3	6	1	1	12	1	6	61·9	
Derby	10	5	1	7	2	5	9	3	1	60·5	
Yorkshire	11	7	9	10	7	13	18	7	11	41·9	
Westmoreland	1	1
Lancashire	8	12	8	7	9	12	12	5	14	31·0	
Anglesey	2	3	1	1	...	1
Carnarvon	7	3	3	5	1	2	4	6	3	47·1	
Merioneth	3	1	1	4	...	...	7	1	...	82·4
Cardigan	3	1	...	4	...	3	7	...	2	70·0	
Pembroke	1	...	1	...	...	2	1	...	1	...
Carmarthen	7	1	...	1	1	4	3	1	3	52·4	
Isle of Man . . . . .	...	...	...	...	1	1	4	1	...	...
Ireland	1	1	1	...	1	5	4	4	5	22·7	
Total	445	148	121	494	174	240	650	148	261	59·2	
Per cent	62·3	20·7	16·9	54·4	19·2	26·4	61·4	14·0	24·6	...	

Sound-Area

Records of the earthquake-sound have been received from 1097 places. Nearly one-half of these are in the seven central counties, and they become gradually more scattered as we recede from the origin, so that the number of stations for determining the boundary of the sound-area is too small to allow of it being accurately drawn. On this account, it is not shown on the map of the earthquake; but, for the most part, the approximate boundary lies between the isoseismals 5 and 4, and is less nearly circular than either of these lines. Its length, from north-west to south-east, is 320 miles, and its breadth 284 miles, and the area contained by it about 70,000 square miles. Towards the north-west it coincides approximately with the isoseismal 4; but it does not extend so far towards the south-east by about 33 miles.

Isacoustic Lines

Isacoustic lines may, in the first place, be defined as lines of equal sound-intensity. The obvious method of drawing them would be to devise a rough scale of sound-intensity similar to the Rossi-Forel scale of seismic intensity, and I have on several occasions tried to do this, but unsuccessfully. One of the chief obstacles met with is the fact that the test-sound for each degree of the scale must be one produced at a given distance from the observer. The neighbourhood of the earthquake-sound to the lower limit of audibility of most persons is also an important difficulty. But when the number of observers is great, as it is in the case of the Hereford earthquake, another method becomes applicable. This is to make use of the percentage of observers within a given district who recorded their perception of the earthquake-sound. So that, from this point of view, isacoustic lines might rather be defined as curves of equal sound-audibility.

If we take any point on the isacoustic line marked 80 (Fig. 13), and describe a circle with that point as centre and with any radius that is small compared with the diameter of the curve, then 80 per cent of the observers within that circle would hear the earthquake-sound. If the period of the sound-vibrations be the same at every point of the curve, then it follows that their amplitude must also be the same, *i.e.* the sound at all points of the curve must be of the same maximum intensity. On this assumption, then, we see that curves of equal sound-audibility are also curves of equal sound-intensity, and therefore that the two definitions of isacoustic lines agree.

The numbers of observers who heard the earthquake-sound are given in the preceding Table. In the last column will be found, for each county, the percentage of the total number of observers who recorded their perception of the sound. The figures in this column are those which have been used in the construction of the isacoustic lines in Fig. 13.

To draw the curves with a close approach to accuracy, a much smaller unit of area than the county should have been chosen, and a unit-area of constant dimensions would also have been desirable. But this would have required a very much larger, and more uniformly distributed, series of observations than is at our disposal. I have therefore retained the county as the unit-area, with the exception of Yorkshire, where the three Ridings have been treated as separate counties. At the centre of each county, I assume that the sound-audibility may be regarded as proportional to the percentage of the total number of observers within the county who distinctly heard the sound. In order to draw the curve marked 50, the centre of every county in which the average percentage is less than 50 is joined to the centres of those adjoining counties in which it is above 50, and this

line is then divided in the proper ratio so as to give a point where the percentage would be exactly 50. If, for instance, the average per-

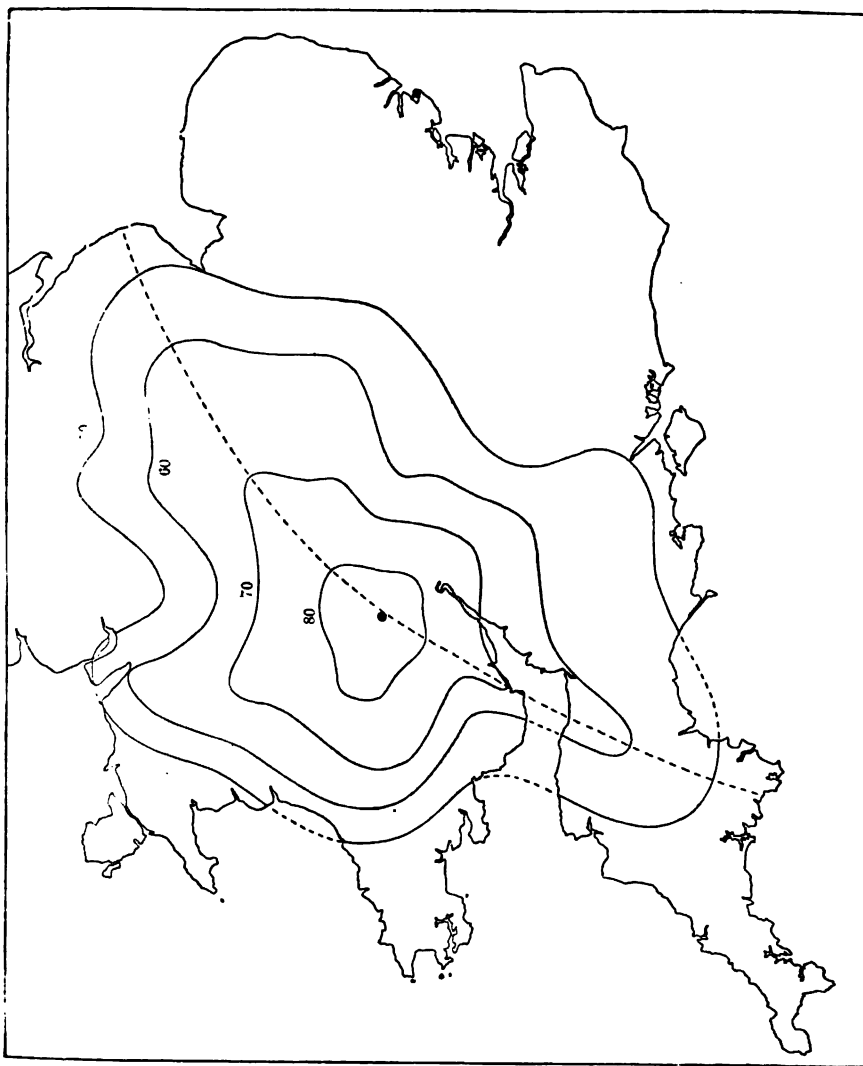


FIG. 1B. Map of Lancashire 1890.

centage in one county were 39·6 and in the next 56·5, the line joining the first centre to the second would be divided in the ratio 10·4 to 6·5, i.e. of 8 to 5. A number of points at which the percentage is 50

is thus obtained, and the curve drawn through them is the required isacoustic line.

The highest percentage in any county in England and Wales is 87·2 in Herefordshire, and the lowest 23·1 in Essex. The number of counties where the percentage is below 50 is small, however, and I have therefore only drawn the isacoustic lines corresponding to the percentages 50, 60, 70, and 80. Fragments of other lines might be drawn, but the resulting gain would be small.

The peculiar form of the isacoustic lines will be evident at a glance. Their greatest extensions are not along the axes of the isoseismal lines, but in two directions which are a little east of north-east and a little south of south-west. The principal projections lie along the dotted hyperbolic line in Fig. 13, and it will be noticed how closely this agrees with the curvilinear axis of the hyperbolic band as shown on the map of the earthquake.

It will be remembered that this band is the area within which the series of vibrations from the two foci are superposed. The isoseismals are not, however, sensibly distorted when crossing this band, though there is some doubt whether the isoseismal 5 should not be deflected towards the south-west so as to include Torquay and Bowden (near Totnes). Why, then, should the union of the two series of vibrations have so marked an effect on the isacoustic lines and so slight an effect on the isoseismals?

The explanation seems to me as follows. The maximum amplitude of the vibrations which produced the shock was considerably greater at the north-west than at the south-east focus. Hence, when, at any point in the hyperbolic band, the vibrations from the north-west focus were reinforced by those from the south-east, the resulting increase in the intensity of the shock was not very marked. On the other hand, the maximum intensities of the vibrations which were sensible as sound did not differ very greatly at the two foci, and therefore the addition of one series of sound-vibrations to the other resulted in a notable increase of the sound-intensity, with the natural consequence that a larger number of persons heard the sound.

Thus, the study of the isacoustic lines strikingly confirms the conclusions at which we arrived in the last chapter, namely, that there were two distinct, or nearly distinct, parts of the seismic focus arranged in a north-west and south-east line, and that the fault-slip at the former part occurred a few seconds earlier than that at the latter.

Nature of the Sound

The noise which accompanied the shock is often described by such terms as "a deep booming noise," "a lumbering sound," "a dull heavy rumble," "a grating roaring noise," "a harsh growl," "a mysterious suppressed roar," "a sort of low moan or grumbling," or "a strange

deep sort of groan or moan." This is the usual character of the sound in British earthquakes. But, in the Hereford earthquake, there were sounds of a totally different kind, observed either alone or in conjunction with the preceding sounds, that are described by the terms "rustling," "a hissing windy sound," or "a loud hissing rushing sound." No fewer than 15½ per cent of all the observers who definitely describe the sound, compare it to the rushing of wind or something similar.

The chief characteristic of the rumbling sound seems to have been its extraordinary depth, as if it were almost too low to be heard, and, with many persons, this was indeed the case. According to an observer at Davenport, in Cheshire, it was "a low rumbling sound . . . much lower than the lowest thunder." "I can only compare the sound," says another, at Clifton, "with the vibrations of the pedal notes of a great organ, only of a deeper pitch than can be taken in by the human ear, shall I say a noise more *felt* than heard?" The same lowness of pitch seems also to be implied by the frequent use of the word "heavy," in such comparisons as "a heavy traction-engine," "a heavily-laden goods train," or even "a very heavy blast of wind." In a list which I have made of all the different expressions used in each county to illustrate the nature of the sound, the words "heavy" or "heavily" occur in one out of every four cases. And this is not confined to the counties immediately surrounding Herefordshire; the same proportion holds true in the more distant counties.

To many observers the sound was of short duration, as is evident from their comparing it to explosions or to the fall of heavy bodies. Partly, this may have been due to their only waking in time to hear the conclusion of the sound; but, in many cases, perhaps generally, to the fainter terminal sound being drowned by other noises; just as, to a person in a busy street, a peal of thunder sounds like the crash of falling timber.

Another point of less importance is the frequency with which observers compare the sound to that of a vehicle of some kind driven *quickly* past. I am not quite certain in what sense this comparison is made. It may be to illustrate the evenness or smoothness of the sound, and this explanation is in part supported by other descriptions. But, as a general rule, I think the impression is produced by the rapidity with which the sound attained, and receded from, its maximum intensity.

Types of Earthquake-Sound.—While some observers preferred to describe the sound in terms such as those quoted above, by far the larger number have compared it with some more or less well-known type. The series of observations collected in Chapter II. being unusually extensive, it seemed to me that it might be interesting to classify the different types referred to.

Nearly half the comparisons made are to passing vehicles of various

kinds. The "laboured rumble" of the ubiquitous traction-engine is of frequent occurrence in the lists. It may be the passing of one or several traction-engines, or occasionally of a very heavy traction-engine, either alone or heavily laden, *e.g.* drawing trucks of stone; going up a hill or crossing a bridge, sometimes at full speed (15 miles an hour in one case) or driven furiously past. The less familiar steam-roller is sometimes invoked, passing over frozen ground or at a quicker pace than usual. The many different comparisons to passing waggons show how closely their sounds have been observed. We have a heavy waggon coming apace down a hill, driven over stone paving, along a macadamised road, on a hard or frosty road, or over a bridge (as heard from below); a large empty waggon going over a rough road, or loaded waggons of coal running down an incline; a long string of farmers' heavy springless waggons; heavy carts on a hollow road or in a covered way; big furniture-vans driven at a trot or over a grating; a fire-engine at a rapid pace, Cheapside traffic, or the charge of a battery of artillery over a macadamised road; and, in a few rare cases, a heavy stone roller dragged along a floor, a wheelbarrow trundled on a hard and frosty road, or the rolling of a lawn by an extremely heavy roller. Quite as frequent and detailed as any of the above are the allusions to express trains and heavy goods or mineral trains. Thus, we have the roar of an express train going through a tunnel, a very resonant tunnel according to one observer; trains rushing through a station, in a deep cutting, under or over an arch, or underground; crossing a wooden bridge, a suspension bridge, a wide-span girder bridge, or a girder bridge with a wooden floor, the observer being generally, I think, supposed underneath but sometimes at a distance; and, again, an empty goods train over an iron viaduct, a goods train running on hard frosty ground, a muffled train passing over a bridge, and a heavy train running on snow. Occasional references are also made to sounds of a similar nature, such as the dragging of heavy furniture across an adjoining floor, the forcing of a heavy door over a risen stone pavement, the rolling of an empty barrel in a cellar, heavy barrels being got down cellar steps, dozens of hard balls rolled over boards, the grating of a boat on the beach when being landed, or of the bottom of a large vessel when dragged over rocks.

The comparisons to thunder are also numerous, a loud clap, a violent or heavy peal, very deep thunder in one case, and heavy thunder but very sharp in another; sometimes qualified by the words "dull," "muffled," or "subdued"; most often by the word "distant," and thus conveying the impression of a low deep rumble or booming sound.

How much more carefully wind has been observed than thunder is evident from the extraordinarily varied and detailed accounts. Sometimes it is simply wind, a storm, a hurricane or a whirlwind; "a rushing mighty wind" is a favourite, and no doubt an apt, expression;

and, again, a moaning, roaring, howling, rushing, hissing, or rough strong, wind; or it may be a tremendous hurricane, a furious or very heavy blast of wind, a very strong gale, a violent or sudden gust, the roaring of a great squall, or the southing of a high wind. Not a few observers mention the approach of wind or a hurricane, such as the rising of the wind, wind getting up in the distance or in a sudden squall, a noise such as precedes a violent storm of wind. Some refer to a steady gale pressure, a heavy wind pressing against the house, or a strong wind pressing against the door. Others describe the sound as a high wind sweeping through trees, a strong wind passing through leafy trees in summer, and one as a tornado driving through a forest. The howling wind in a chimney is a type occasionally referred to, and leads up to the rushing of air up a chimney on fire, and thence to the roaring of a very large fire, the rush of flame and an oil-factory on fire.

Among the sounds of shorter duration may be mentioned the tipping of a load of coal, stones or bricks; heavy bales or a large body of masonry falling, the crash of a chimney through the roof, and the falling of great stones into some unfathomable abyss. Still shorter are the fall of a heavy weight or of a tree, the muffled fall of a great mass of earth, the fall of a heavy weight wrapped in felt, the thud of a large mass of snow from the house-top, a heavy mattress falling, the banging of a door only more muffled, and the blow of a wave on the sea-shore.

Under the same heading, as regards duration, may be reckoned the sound of explosions; for example, the explosion of a boiler, of gas, gunpowder in a pit, a cartridge of dynamite, and a more or less distant colliery explosion. Other comparisons are to distant heavy rock-blasting, platoon-firing, artillery practice, and the boom of a distant cannon.

The following types are of a miscellaneous character, and none of them is of frequent occurrence. We have, for instance, cows rushing on the turf below, a quick stampede of a large herd of elephants, farm-boys trampling heavily underneath, or a number of powerful men struggling desperately in the room overhead; the roar of a large quantity of water, such as the bursting of a reservoir or a waterfall heard from a distance; the roaring of lions, the whizzing of large wings, snow sliding on the roof, the passage of a party of skaters, or of boys with hob-nailed shoes sliding on rough ice, the flowing of the sea on a pebbly shore, the rattling of iron bars, and a soft roll on a big drum. The last two are suggestive of the origin of earthquake-sounds,—as if huge pieces of rock were settling together; and the noise as of rending rocks below, suggesting the idea of great depth, as if miles of rock were being torn asunder and very deep strata being dislocated.

The total number of comparisons made is 1264. Of these, 45·4

per cent refer to passing waggons, trains, etc., 15.0 per cent to thunder, 15.5 per cent to wind, 6.6 per cent to the fall of stones or heavy bodies, 7.2 per cent to explosions, while 10.3 per cent belong to the miscellaneous sounds described in the last paragraph.

Nature of the Sound in the Neighbourhood of the Epicentre.—At most places the sound seems to have adhered in character to one of the types mentioned above, and to have varied, if at all, only in intensity. At some, however, the character itself changed, and the following accounts are therefore given to illustrate the nature of the sound at different places chiefly in the epicentral district, the first four being in Herefordshire and the last two in Gloucestershire.

Hereford: a noise like that of a heavy cart approaching from a distance, increasing in intensity until it resembled a heavy traction-engine passing, followed by two distinct crashes, each like a heavy chimney falling, with a slight pause between them, after which the sound died away suddenly.

Dilwyn: the rumbling of a train going over a bridge, with a terrific crash such as is heard in a thunderstorm at the instant when the shock was strongest, the rumbling dying away afterwards for some seconds.

Hagley: the sound commenced very softly and then rapidly increased in volume and intensity, towards the end (when the vibrations were strongest) becoming rougher and more grating.

Llandinabo: a sound as of a number of very heavily loaded waggons coming swiftly near and dying off almost suddenly, at the moment when the shock was strongest being like the roll and clatter of thunder below, accompanied by a grinding noise.

Horsley: first like a violent wind among trees, then, while the shock lasted, like a very heavy traction-engine close to the house, increasing in intensity and then dying away, the sound being loudest when the shock was strongest, and at the same moment the rumbling was accompanied by a sort of grinding noise, which appeared to be under the house and sounded as if a landslip were in progress.

Uley: first, like a wonderfully heavy waggon rolling along the road; then it seemed to come round the house and the noise became very loud like thunder underneath and a crash as of a cartload of falling stones; at the same instant the observer's bed was violently shaken.

Variation in the Intensity of the Sound.—The number of observations on this point is 253. In more than half (55.7 per cent) the intensity gradually increased to a maximum and then died away; in 9.5 per cent the sound is said to have been uniform in intensity, probably, I think, owing to the suppression of the weaker terminal sounds; while, in the remaining 34.8 per cent, the sound was observed to grow gradually louder and to stop more or less suddenly, or else to begin abruptly and die away gradually. The latter cases are generally those

in which the sound appeared to precede or follow the shock entirely, and thus the terminal abruptness was subjective and due to the observer's inability to hear the deeper sounds which accompanied the shock.

Variation in the Character of the Sound.—The accounts given above illustrate the manner in which the sound varied in the neighbourhood of the epicentre. Generally speaking, in this district the rumbling noise, at the moment when the shock was strongest, assumed a rougher, more grinding or grating character, occasionally, but not often, being heard as a loud crash. Outside the central counties, observations of any change in the character of the rumbling sound during the progress of the shock are comparatively rare. But there are many others in which a change was marked at or about the instant when the shock began or ceased to be felt. This is especially the case when a rushing sound like wind was heard. At a few places, this latter sound and the shock were observed concurrently, but most often the records are of the following types. At Elmsdale, near Wolverhampton, the shock was preceded by a rushing sound as of a mighty wind going at a great pace, and then a rumbling noise accompanied the vibrations, the roar of which grew in intensity so as to be almost deafening, until it ended in a loud dull thud coincident with the final vertical motion. At Holt, in Denbighshire, a peculiar hissing sound was heard, as of trees rustling, drawing gradually nearer and nearer and gaining in volume, as though a cart were passing over pavement, and at this instant the shock was felt. At Pontnewydd, near Pontypool, following instantly on the dying away of the tremor, a rumbling sound was heard, as if a heavy dray were passing, gradually dying away in about two seconds, and followed by a sound as of rushing wind which lasted for one or two seconds more. Lastly, at Batley, in Yorkshire, the shock was preceded and followed immediately by [a sound as of] a rushing wind, and was accompanied by a low rumbling noise like distant thunder.

It thus appears that, as the shock increased and decreased in intensity, the sound grew louder and died away and also deepened and rose in pitch; in other words, the vibrations which were observed as shock and sound increased and decreased together in amplitude and period.

Variation in the Nature of the Sound throughout the Sound-Area.—In estimating the effect of distance on the nature of the sound, the county is, with one exception, too small an area to take as a unit, on account of the rarity of observations on the points considered in many of them. For a rough analysis, I have therefore divided the sound-area into three districts, (1) the central counties of Hereford, Gloucester, Worcester, Shropshire, Radnor, Brecon, and Monmouth; (2) an inner ring of counties, namely, Somerset, Wiltshire, Berkshire, Oxford, Warwick, Birmingham, Stafford, Cheshire, Flint, Denbigh,

Montgomery, and Glamorgan; and (3) an outer ring consisting of the remaining counties in which the sound was heard.

One effect of distance would naturally be to quench the weaker sound-vibrations at the beginning and end, and we should therefore expect to find less variation in the intensity of the sound at a distance than near the epicentre. This certainly is the case, but the change is not at all a marked one, as will be evident from Table IV. The figures for the outer ring of counties do not, indeed, differ much from those for the inner ring; the explanation probably being that the majority of observations from the former come from the counties bordering its inner margin.

TABLE IV

EFFECT OF DISTANCE ON THE VARIATION IN THE INTENSITY
OF THE SOUND

District.	No. of Observations.	Sound increased to a maximum and then died away.	Sound of uniform Intensity.	Doubtful.
Central counties	150	57·3 p.c.	8·0 p.c.	34·7 p.c.
Inner ring . .	54	53·7 „	11·1 „	35·2 „
Outer ring . .	49	53·1 „	12·2 „	34·7 „

If we may judge from the frequency with which the words “heavy” and “heavily” occur in the descriptions, the sound seems to have been everywhere of the same low pitch. Taking all the different comparisons in every county, the above terms occur in 26, 27, and 24 per cent of the total number for the central counties, the inner ring, and the outer ring respectively.

This uniformity, however, disappears to a certain extent when we consider the different types of comparison employed. In Table V. are given the percentages of the total number of each of the more important types referred to.

TABLE V

EFFECT OF DISTANCE ON THE NATURE OF THE SOUND

District.	Waggons, Trains, etc.	Thunder.	Wind.	Fall of loads of stones.	Fall of heavy bodies.	Explosions.	Miscel- laneous.
Central counties	44.9	17.5	13.7	4.4	2.0	8.2	9.3
Inner ring . .	42.6	13.9	16.0	4.5	3.9	6.9	12.1
Outer ring . .	49.0	11.5	18.3	2.2	2.8	5.6	10.6

From this Table it appears that, as we recede from the origin, the sound becomes on the average less like thunder or explosions and more like wind. Whether this is an effect of distance only, I cannot say, as it is impossible to examine the distribution more closely, owing to the small number of observations.¹

The case is different, however, as regards the references to passing waggons, traction-engines, trains, etc.; for these form nearly one-half of the total number of descriptions. It will be seen, from the Table, that their comparative frequency at first decreases and then increases, so that the variation is not a simple effect of distance only. The reason for this becomes clear if we represent the distribution of these sounds graphically by the same method as that used in the construction of isacoustic lines. The curves in Fig. 14 represent equal percentages of comparisons to passing waggons, etc., out of the total number of comparisons; that is, if with any point on the curve marked 50, for instance, a circle be described whose radius is small compared with the diameter of the curve, then 50 per cent of the observers within that circle who describe the sound would refer it to the type of passing waggons. In the north-west part of the area depicted the curves are incomplete, owing to the scantiness of observations in North Wales.

The data on which the curves are founded being less definite than those on which the isacoustic lines depend, the former are correspondingly less accurate. Their form and position are, however, striking,

¹ I have examined the distribution according to direction, taking the comparisons in seven counties along the axis of the isoseismals and in eight counties perpendicular to that axis, but without much success. It may be worth mentioning, however, that the references to sounds of short duration (explosions, fall of heavy bodies and loads of stones) are relatively as numerous along the axis as at right angles to it, the percentage of the total number in each case being 15.1 and 16.8.

and especially the approximate connexion of the curves of higher percentage with the extremities of the hyperbolic band. The explanation of this peculiarity appears to me as follows.

In order to obtain comparison with a passing waggon, etc., the sound must be of some, but not necessarily of great, duration, for the



FIG. 14.—Curves of Equal Percentage of Comparisons to Passing Waggons, etc.

references are so frequently made to the *rapid* transit of vehicles. Moreover, there must be a certain uniformity in the sound, and it must increase or decrease continuously in order to give the requisite impression. In Herefordshire and the other central counties, we should not therefore expect to find a large percentage of examples of this type; they should on the whole become relatively more common

at a greater distance from the centre. Again, near the boundaries of the hyperbolic band and at some distance from the centre, the uninterrupted duration of the sound would be greater than elsewhere, and therefore in these districts comparisons would naturally occur with greater frequency.

Anomalous Phenomena.—Reference has been made several times in the foregoing pages to the unequal perceptive powers of different persons with regard to earthquake-sounds; and it is indeed on this fact that the possibility of constructing isacoustic lines depends.

Some examples of these differences may now be given, as they presented themselves to observers who were awake when the earthquake occurred.

In the first place, it happens frequently that in one and the same town or village, the sound was audible to some observers and not to others. For instance, at Clifton two out of five observers who were awake did not hear the sound, at Leamington two out of six, in Birmingham and the neighbouring district four out of twenty-three, in London eight out of eighteen, and at Bangor two out of seven. That this difference was due to the observers and not to the conditions in which they happened to be placed, is evident from the fact that in the same house, and even in the same room, one observer heard the sound, while to another it was inaudible. The total number of persons who were awake and heard no sound is 148. All but five of these were situated within the boundary of the sound-area and at places which, when plotted on a map, are seen to follow no law of distribution with reference to the position and direction of the originating fault, and lie in the immediate neighbourhood of others where the sound was heard.

Even when observers in the same place agreed in hearing the sound, it presented itself to them in different forms. Thus, at Hereford, a crash or bomb-like explosion was noticed during the rumbling sound by four observers, while four others describe the sound in terms which imply uniformity of character. Again, at Pridewood (five miles from the centre), one observer, who felt two series of vibrations and heard a loud crash with the maximum of each series, remarks that only a few heard this peculiar sound, although most persons noticed a premonitory rumbling. At Ledbury, the sound according to one¹ began like a rushing wind and culminated in a loud explosive report; another heard a noise like distant thunder which ended when the shock began; while a third heard no sound at all.

At places farther away from the centre, we find the same diversity both in character and intensity. At Clifton, for instance, one person heard a slight rumbling noise, while another compared the sound to that of a heavy traction-engine passing. In the Birmingham district, the accounts refer on the one hand to the distant approach of a train

¹ This observer was awakened by the sound.

and the rising of the wind, on the other to the reports of large cannons and to a noise as if tons of débris had been hurled against the wall of the house; at Exeter, to a soft roll on a big drum and the rumbling of a traction-engine passing; at Sheffield, to a very faint rumbling noise and to stone-carts going down the hill; and at Bangor, to muffled thunder, wind through trees, and a loud rumbling sound. At all of these places, moreover, there were one or more persons awake who heard no sound.

Again, a number of observers who heard the sound ($8\frac{1}{2}$ per cent of those who were certainly awake) expressly state that they were unconscious of any sound while the shock lasted. Thus, at Broseley, in Shropshire, the noise resembled the approach of a steam-roller or traction-engine up the street; it became continually louder and ceased as the shock began. At Condover, in the same county, the sound was like the galloping of a heavy traction-engine, and it died away on the commencement of the shaking. At Caersws, in Montgomeryshire, no sound was heard until the shock was dying away, and it was then very low, something like a train crossing a wooden bridge at a distance. Lastly, at Stoke Bishop, near Bristol, the shock was preceded by a faint rumbling noise like extremely distant thunder, lasting about two seconds; then, after an interval of about one second, the shock commenced, but while it lasted the observer was not conscious of any sound; immediately the vibration ceased, a faint sighing or moaning was heard for about two seconds.¹

The number of observations of this kind is 119, in 91 of which the sound entirely preceded the shock, in 26 entirely followed it, while, in the two others, the sound was heard before and after, but not during, the shock. The distribution of the places where the observations were made does not seem to follow any law with reference to the position and direction of the originating fault; but, regarding only those persons who were awake at the time and heard the sound, the observations are relatively more numerous as the distance from the centre increases, the percentage being 7·4 in the central counties, 8·7 in the inner ring, and 10·3 in the outer ring.

That this curious cessation of the sound was inherent to the observers and not due to their position, is evident from the fact that the sound was heard by others at many of the places where the observations were made, for instance, at Hereford, Wotton-under-Edge, Leamington, etc. At Presteign, in Radnorshire, to one observer the sound ceased before the vibrations commenced; to another, the sound was terrible, as of rending rocks beneath his feet, and was loudest at the time when the shock was strongest. At Birmingham, one observer heard the sound before, during, and after the shock, another entirely

¹ A similar observation was made at Bishop's Castle by an observer who was asleep at the beginning. A loud rumbling muffled sound seemed to roll up the street, to cease during the shock, and immediately afterwards to continue rolling up the street.

before it, a third only after it, while others, as already remarked, heard no sound at all.

All these apparently anomalous phenomena seem to admit of one explanation.

For a given observer, the deeper the sound, the greater must be the intensity of the vibrations required to render it audible. Thus, as the vibrations which reach him increase in period, it may happen that, sooner or later, the intensity of some does not attain or exceed that limiting value, and, at that moment, the sound will cease to be heard.

Moreover, for vibrations of a given period, this limiting value varies for different persons.¹ Thus, to one observer, the sound may become inaudible, while another may continue to hear it.

Again, the vibrations which affect an observer at any moment, are of various amplitude and period. One may hear all perhaps, while a second may be able to hear some and not others. Thus, to one observer, the sound may be like a rising wind, to another like a heavy traction-engine passing; one may hear the crashes or bomb-like explosions which accompanied the most prominent movements, while a second may be deaf to the same vibrations; to one the sound may become continually louder and cease abruptly, to another it may increase to a maximum and then die gradually away.

Relation of the Sound to the Double Series of Vibrations

Owing to the absence of any definite question in my lists, the observations on this subject are few in number. They are, however, sufficiently decisive on one point, namely, that in a large part of the disturbed area where the two series of vibrations are distinct, there are also two series of sound-vibrations separated by an interval of complete silence. Even Herefordshire, where the intermediate sound would, if anywhere, have been heard, forms no exception to this statement; and indeed it is in this county and the adjoining counties of Gloucester and Worcester that we have the majority of records (14 out of 19) of the double sound. The other places are Court of Hill (Shropshire), Napton and Warwick (Warwickshire), Garth Hill (Glamorgan), and New Barnet (Hertfordshire).

The sound accompanying the first series of vibrations was the louder at Withington (Herefordshire) and Belbroughton (Worcester-

¹ It also varies in the same person, for "near the limit of hearing," as Lord Rayleigh remarks, "the ear is very rapidly fatigued; a sound in the first instance loud enough to be disagreeable, disappearing after a few seconds. A momentary intermission, due, for example, to a rapid passage of the hand past the ear, again allows the sound to be heard" (Abstract of a lecture on "The Limits of Audition," *Nature*, vol. 56, 1897, p. 285). The more or less sudden cessation of the sound when the shock begins may thus sometimes be due to fatigue, but we cannot in this way account for the cases in which the sound only began to be heard on the termination of the shock.

shire); that accompanying the second series was louder at Ruardean and Whitecroft (Gloucestershire) and Napton, and probably also at New Barnet. The first two places lie on the north-west, and the last four on the south-east, side of the curvilinear axis of the hyperbolic band. Thus, the stronger series of vibrations was attended by the louder sound.

The interval between the two sounds is estimated in seven records, and these give an average of 2.9 seconds for its duration, the limits being one second at Belbroughton and five seconds at Garway (Herefordshire). The average is therefore about three-quarters of a second less than that for the average interval between the two series of vibrations, and this is what we should expect, for the sound might in some cases intrude upon the latter interval at one or both ends.

At several places where two series of vibrations were felt, the sound was only heard with one of them. On the north-west side of the hyperbolic band, the sound was heard with the first series only by observers at Compton (near Wolverhampton), Stoke-upon-Trent (probably), New Ferry (near Birkenhead), and Pendoylan (Glamorgan), and with the second series at Lenton (near Nottingham). On the south-east side it was heard with the second series at Wick (near Pershore) and Kettering, and with the first at Shaw (Berkshire) and Minley (Hampshire). In the majority of cases, the single sound was therefore heard only with the stronger series of vibrations; but it will be noticed that nearly all the places mentioned lie at a considerable distance from the centre.

Time-Relations of the Sound and Shock

In the following Table are shown the time-relations of the three principal epochs of the sound and shock, namely, the beginning, the epoch of maximum intensity, and the end; the figures in the columns headed *p*, *c*, and *f* giving the numbers of observations in which any one epoch of the sound preceded, coincided with, and followed, the corresponding epoch of the shock. Cases in which the whole of the sound preceded the shock are, however, excluded from the columns headed "Epoch of Maximum Intensity" and "End"; for, in all probability, these are due to the observer's inability to hear low sounds. A similar remark applies to the cases in which the sound entirely followed the shock.

TABLE VI.—TIME-RELATIONS OF SOUND AND SHOCK

County.	Beginning.			Epoch of Maximum Intensity.			End.		
	p.	c.	f.	p.	c.	f.	p.	c.	f.
Hereford	61	12	8	4	19	1	8	15	9
Gloucester	52	8	8	2	19	...	9	10	18
Worcester	58	4	5	5	10	...	11	11	13
Shropshire	38	5	2	2	8	1	8	5	9
Radnor	18	...	...	...	2	...	1	...	8
Brecon	12	1	1	1	4	...	...	1	7
Monmouth	27	3	...	1	6	...	3	4	8
Somerset	12	2	...	2	...	...	8	4	4
Wiltshire	11	4	1	2	...	...	4	1	8
Berkshire	5	3	...	...	...	...	2	2	...
Oxford	8	...	...	...	2	...	...	...	2
Warwick	11	4	2	...	1	1	...	3	6
Birmingham	29	...	2	...	...	...	3	1	10
Stafford	17	1	1	1	...	...	5	1	5
Cheshire	7	2	2	...	1	...	1	...	4
Flint	2	1	...	1	1	...	...	2	1
Denbigh	5	2	...	...	...	...	...	1	1
Montgomery	12	1	...	2	1	1	1	4	2
Glamorgan	7	4	3	...	2	...	3	5	4
Devon	12	1	1	...	2	...	2	4	6
Dorset	2	...	1	...	...	...	...	...	2
Hampshire	4	...	...	...	...	...	1	...	1
Sussex	1	...	...	...	...	...	...	...	...
Surrey	5	...	...	...	...	...	...	1	2
London	7	2	...	...	...	...	1	1	2
Middlesex	2	...	...	...	...	...	...	...	1
Hertford	7	...	...	...	...	...	...	...	1
Bedford	1	...	...	...	...	...	...	...	1
Buckingham	7	...	2	...	...	1	...	2	3
Huntingdon . . . . .	...	...	1	...	...	...	1	...	...
Cambridge	1	...	...	...	...	...	...	...	...
Suffolk . . . . .	...	...	...	...	...	...	...	...	1
Norfolk	1	...	...	...	...	...	...	...	...
Northampton	7	3	...	...	1	...	2	2	1
Leicester	7	...	...	...	1	1	...	2	3
Rutland	3	...	...	...	...	...	...	...	...
Lincoln	2	1	1	...	...	...	...	...	...
Nottingham	13	1	2	...	1	...	3	...	...
Derby	6	1	1	...	1	...	1	1	4
York	9	...	2	...	...	...	1	...	2
Lancashire	8	...	...	...	...	...	...	...	2
Anglesey	1	...	...	...	...	...	...	...	...
Carnarvon	5	2	2	...	1	1	1	2	4
Merioneth	6	1	1	...	5	...	1	1	2
Cardigan	2	1	...	...	1	...	...	...	...
Pembroke	1	...	...	...	...	...	1	...	1
Carmarthen	4	1	...	...	1	...	...	2	1
Isle of Man	1	...	...	...	...	...	...	...	1
Wicklow	1	...	...	...	...	...	...	...	1
Total	508	71	39	25	85	7	72	88	161
Percentage of each epoch	82.1	11.6	6.4	21.4	72.6	6.0	22.4	27.4	50.2
Do., observers awake	79.1	13.4	7.5	25.5	70.2	4.3	19.8	28.6	51.6
Do., observers asleep	82.0	12.7	5.3	18.6	74.4	7.0	32.4	26.5	41.2

Thus, as a general rule, the beginning of the sound preceded that of the shock, the sound was loudest when the shock was strongest, and the end of the sound followed that of the shock. To the last statement, however, the exceptions are more numerous than to the two others.

Of the observers (201 in number) who noted the time-relations of both beginning and end of the sound and shock, 54 perceived the sound before, during, and after the shock; 24 heard the beginning of the sound precede that of the shock and their ends coincide, and 8 heard them begin together and the end of the sound followed that of the shock; according to 40 observers, 19 of whom were certainly awake, the terminal epochs of sound and shock coincided, while 12 others noticed the sound to begin after, and end before, the shock. In other words, the numbers of persons who considered the sound of greater, equal, or less duration than the shock were 86, 40, and 12 respectively. Most of the remaining 63 observers furnish no decisive information on this point in the absence of definite time-estimates.

The last two lines of Table VI. show how slightly the time-relations of the beginning of the sound and shock are affected by the temporary condition of the observer. Whether awake or asleep, the percentages are nearly the same. It is, of course, possible that some persons may have become fully awake just at or after the end of the first series of vibrations, in which case their observations would refer to the second series only. But the number of records for the initial epoch being comparatively large, this does not seem a complete explanation; and it is more reasonable to infer that observers, who were capable of hearing the low sound-vibrations, were in most cases awakened by them at an early stage. This conclusion is of some importance, as it enables us to make use of the whole series of observations on the time-relations of the sound and shock, instead of confining us to the smaller number in which the observer was awake when the earthquake began.

Time-Relations of the Sound and Shock with regard to Space.—The figures in Table VI. should enable us to draw nine series of curves representing equal percentages of observers who noticed any one of the three epochs of the sound precede, coincide with, or follow the corresponding epoch of the shock. In every case, however, the observations are too scanty to furnish reliable results, the least objectionable being those in which the beginning of the sound preceded that of the shock. I have drawn the curves in this case, but they are so unsatisfactory, on account of the deficiency of data at important points, that I do not venture to reproduce them. In one respect, however, I think they may be trusted, namely, in their marked extensions approximately in the directions of the two arms of the hyperbolic band and towards the north-west along the axis of the isoseismal lines. In other words, in

these three directions a greater proportion of the observers noticed the sound before the shock than elsewhere at the same distance.

As the graphic method fails to give satisfactory results, it will be worth while to analyse the figures for the three districts mentioned above, namely, the central counties, the inner ring, and the outer ring of counties. Table VII. gives the percentages for each epoch in which that epoch of the sound preceded, coincided with, or followed that of the shock.

TABLE VII

TIME-RELATIONS WITH REGARD TO DISTANCE

District.	Beginning.				Epoch of Max. Int.				End.			
	No. of obs.	p.	c.	f.	No. of obs.	p.	c.	f.	No. of obs.	p.	c.	f.
Central counties	303	84.5	11.0	4.6	80	18.7	78.7	2.5	158	22.2	29.1	48.7
Inner ring	187	80.2	12.8	7.0	18	44.4	44.4	11.1	102	24.5	24.5	51.0
Outer ring	154	81.8	9.1	9.1	18	...	77.8	22.2	75	20.0	24.0	56.0

Thus, we see that the cases in which the beginning of the sound preceded that of the shock, and in which the end of the sound followed that of the shock, occur in about the same proportion in all three districts. Moreover, the epoch of maximum intensity of the sound generally coincided with that of the shock in the central counties, but preceded it far more frequently in the inner ring, and again coincided with it in the outer ring.

The latter conclusion is, I think, of considerable importance, and I have therefore endeavoured to analyse the results with regard to direction as well as with regard to distance. Of the counties along the axis of the isoseismal lines, Gloucester and Radnor are in the central district; Wiltshire, Berkshire, and Montgomery in the inner ring; and Hampshire, Merioneth, and Carnarvon in the outer ring. Along a line through the centre perpendicular to the axis, Worcester is in the central district; Warwick, Birmingham, Stafford, and Glamorgan in the inner ring; and Leicester, Lincoln, and Nottingham in the outer ring. Tables VIII. and IX. give the percentages as in Table VII. in these two directions.

TABLE VIII

TIME-RELATIONS IN THE DIRECTION OF THE AXIS

District.	Beginning.				Epoch of Max. Int.				End.			
	No. of obs.	p.	c.	f.	No. of obs.	p.	c.	f.	No. of obs.	p.	c.	f.
Central counties	76	85.5	10.5	4.0	23	8.7	91.3	...	41	24.4	24.4	51.2
Inner ring	37	75.7	21.6	2.7	6	66.7	16.7	16.7	19	36.8	36.8	26.3
Outer ring	22	72.7	13.6	13.6	7	...	85.7	14.3	13	23.1	23.1	53.8

TABLE IX

TIME-RELATIONS PERPENDICULAR TO THE AXIS

District.	Beginning.				Epoch of Max. Int.				End.			
	No. of obs.	p.	c.	f.	No. of obs.	p.	c.	f.	No. of obs.	p.	c.	f.
Central counties	67	86.0	6.0	7.5	15	33.3	66.7	...	35	31.4	31.4	37.1
Inner ring	112	83.0	8.0	9.1	5	20.0	60.0	20.0	60	23.3	18.3	58.3
Outer ring	27	81.5	7.4	11.1	3	...	66.7	33.3	8	37.5	25.0	37.5

In both directions, then, the percentage of observations in which the beginning of the sound preceded that of the shock is approximately the same in all three cases. In the inner ring, the end of the sound followed that of the shock less frequently than in the other districts in the direction of the axis, and more frequently in the perpendicular direction. But the most important result, though it is unfortunate that it should depend on so few observations, is that, in the direction of the axis, the epoch of maximum intensity of the sound generally

coincides with that of the shock in the central counties, precedes it in the inner ring, and again coincides with it in the outer ring; while, in the perpendicular direction, these epochs generally coincide in all three districts.

Explanation of the Apparent Outracing of the Shock by the Sound.—In several strong earthquakes felt in foreign countries, it has been noticed that, at a distance from the epicentre, the sound is heard before the shock is felt. Whether the sound really, or only apparently, outraces the shock in these cases, I am unable to say, being unacquainted with the evidence upon which the conclusion is founded. But, assuming the evidence to be complete, an explanation that would refer the phenomenon to the subjective impressions of the observer appears quite possible.

In the Hereford earthquake, the sound was heard before the shock by 503 observers, and entirely before it by 91, i.e. by 18.1 per cent of the total number. In the eight counties above mentioned which are situated along the axis of the isoseismals, the percentage is 20.4, and in the eight counties along the perpendicular line 20.2. Thus, in the two principal directions, the ratio is the same. Again, in the central counties, the inner ring and the outer ring, the corresponding percentages are 16.0, 19.0 and 21.4; and the inference to be drawn from these numbers is that the difficulty of hearing the deeper sound-vibrations increases with the distance, and consequently that the interval between the end of the sound and the beginning of the shock would also increase with the distance. Hence, if all the observers had been constituted like the 91 above mentioned, the sound would have appeared to them to outrace the shock, and the natural conclusion would be that it travelled with a greater velocity.

Now, as in this country individuals differ greatly in their power of hearing deep sounds, it seems not unreasonable to suppose that other races may also differ from the English, and even be far inferior to them, in this respect. During the Hereford earthquake at least 59.3 per cent of all the observers heard the sound, and in the central county of Hereford no less than 87.2 per cent, and possibly more;¹ while during the great Charleston earthquake of 1886, the corresponding percentage for the central state of South Carolina was only 17.5.² If, then, we suppose an earthquake to occur in a country where the natives have poor auditory powers for deep sounds, the sound would be heard with the shock only near the epicentre, and would apparently outrace it in all directions from that district. I am unable to verify this explanation at present, but it would be easy

¹ In the Inverness earthquake of Nov. 15, 1890, where the disturbed area and sound-area approximately coincided, the percentage is 93.8.

² Capt. C. E. Dutton, "The Charleston Earthquake of Aug. 31, 1886," *Amer. Geol. Surv. Ninth Annual Report*, pp. 496-509.

to apply a test in future earthquakes, provided the observations were numerous.¹

In the case of the Hereford earthquake, this explanation is of course inapplicable. The time-relations of the beginning and end of the sound and shock are conclusive on this point.² So far as the epoch of maximum intensity is concerned, however, the sound has the precedence for some distance along the axis of the isoseismals, though not in the perpendicular direction. I venture to suggest the following explanation of this peculiarity.

In Fig. 15, AB represents the length of the seismic focus, P a



FIG. 15.

point on the earth's surface along the continuation of the fault-line, the distance AP being relatively much greater than that indicated in the figure. The curve AFGB is intended to represent the initial intensity of the sound-vibrations at different points of the focus, the intensity being greatest at C. The vibrations which produce the shock are supposed to come from the central part of the focus, DE; but the curve which represents their initial intensity would probably rise and fall much more suddenly, so that nearly all over the disturbed area the vibrations which produce the strongest shock would proceed from a limited region of the focus not far from the centre.

Now, if P were very near A, or between A and C, the loudest sound-vibrations would come from a part of the focus so near C that we might regard them as coincident. But, if P were at a moderate distance from the focus (say, in one of the counties of the inner ring, in the case of the Hereford earthquake), the intensity there of the sound-vibrations from some point H in AC would be greater than those from C, on account of the smaller distance which separates H from P. Thus, as P recedes from C along the fault-line produced, the epoch of maximum intensity of the sound would precede that of the shock by an interval continually increasing up to a maximum and then decreasing, until at a very great distance the two epochs would again coincide, the ratio of the distances of H and C from P being then nearly one of equality.

¹ Possibly a similar explanation may account for the fact that, in Japan, so many of the earthquakes which originated beneath the land appeared to be unaccompanied by sound.

² The sound was heard after the shock in places so far distant as the Isle of Man and Co. Wicklow

If, on the other hand, the observer's position at P were to recede from the centre along a line perpendicular to the fault-line, the precedence of the epoch of maximum intensity would be very slight, if it existed at all, on account of the probable narrow breadths (in a horizontal direction) of the upper and lower margins of the focus as compared with the lengths of its lateral margins. It need hardly be pointed out that this inference is in complete agreement with the observed phenomena.

CHAPTER IX

DIRECTION OF THE SHOCK

THE late Mr. Robert Mallet was the first seismologist to lay stress on observations of the direction of an earthquake-shock, though he also drew attention to the fact that, at places not far apart, the same shock might be felt in almost opposite directions. Local changes of direction, he remarks, "are due to many causes, principally to changes in the geological formations at different points, or to the structure of the earth's crust, and to abrupt changes in the physical features of the surface of the country."¹ When the seismic focus is of considerable magnitude, the vibrations must travel to points near the epicentre from widely different directions.² In houses and streets, again, the apparent direction of the movement must be influenced by that of their longer axes; and thus a single definite direction of shock may be transformed into very varied impressions.

At one and the same place, the real variation in direction may be sometimes considerable; how great has been shown during the last few years by the evidence of seismographs, and especially by the ingenious model which the late Prof. S. Sekiya constructed to represent the path of an earth-particle during the Japanese earthquake of Jan. 15, 1887.³ But the motion is not always of so complex a character. During the Japanese earthquake of June 20, 1894, for instance, it was extremely simple. At Tokio, which is close to the epicentre, there was one large oscillation, the maximum horizontal displacement being 73 mm. in the direction S. 70° W. and N. 70° E., and this was preceded and followed by comparatively small vibrations. Prof. Omori, who has studied this earthquake, measured the direction in which 245 "ishidoro" and other objects fell within the city of Tokio, the majority of them having circular bases; and, though the directions varied considerably, he found the mean direction of fall to

¹ *Roy. Irish Acad. Trans.* vol. 22, 1855, pp. 406-407.

² "On the theory of vorticose earthquake-shocks," *Geol. Mag.* vol. 9, 1882, pp. 257-265.

³ *Japan Seismol. Soc. Trans.* vol. 11, 1887, pp. 175-177.

be S. 71° W. and N. 71° E., a result in practical agreement with the seismographic evidence.¹ It will be seen that a somewhat similar conclusion may be deduced from the records of the Hereford earthquake.

The number of observations on the direction of the shock amounts to 469; and, considering that no question was asked on the subject, this large number seems to show how strong is the influence still exerted by the views of Robert Mallet.

As a general rule, the determinations of direction are extremely rough. Comparatively few observers refer to any but the eight principal points of the compass. When greater detail seems to be implied by the record, it is sometimes only apparent, and due to reference to the known situation of the house.

That the impression of the direction is a real one is shown by the observations of different persons in the same house, especially of those who were sleeping in the same room and in beds at right angles to one another. There are many cases of this kind, and the observers, with hardly an exception, agree in their estimates of the direction; one, for instance, remarking that the bed rocked from side to side, and the other from end to end.

On one point there is an apparent contradiction which it is not easy to explain satisfactorily. It frequently happens that two observers close to one another agree in stating the same line of action, but differ in giving opposite directions along that line. According to a few persons, the two phases of each vibration were not equally marked, and in these cases the direction of the stronger phase would be adopted. But this observation is a rare one, and generally the to-and-fro movements seem to have been equally distinct. Many observers, it might be thought, would attach the sense of direction to the first prominent movement; but, if so, those who were awake should be practically unanimous in their impressions, while those who were asleep might be nearly equally divided. But this inference is not borne out by the evidence. For of 139 observers who were awake, 58 give the direction from the centre, 42 towards it, and 39 are uncertain; while of 124 who were asleep, the corresponding numbers are 34, 53 and 37. I can only assume, therefore, that personal equation enters very largely into these impressions, unless indeed they are affected by local conditions, of the nature of which I am ignorant.

The distance at which the direction of the shock is perceptible is often considerable, records coming from Brighton (137 miles from the centre), Maldon in Essex (144 miles), Harrogate (147 miles), Douglas in the Isle of Man (167 miles), Dublin (176 miles), and Baltinglass in Co. Wicklow (180 miles).

In Berkshire, ten observers are unanimous in assigning an E. and

¹ *Boll. della Soc. Sismol. Ital.* vol. 2, 1896, pp. 180-188.

W. direction to the movement. But this is the only such instance; and, generally speaking, the apparent directions are very varied. Especially is this the case in the city and suburbs of Birmingham, the area of which subtends but a small angle at the focus. The number of observations here is 37, but in ten of them I am unable to ascertain exactly the positions of the observers' dwellings. The remaining directions are indicated by the arrows in Fig. 16, the arrow-head being omitted when only the line of direction is recorded. The scale

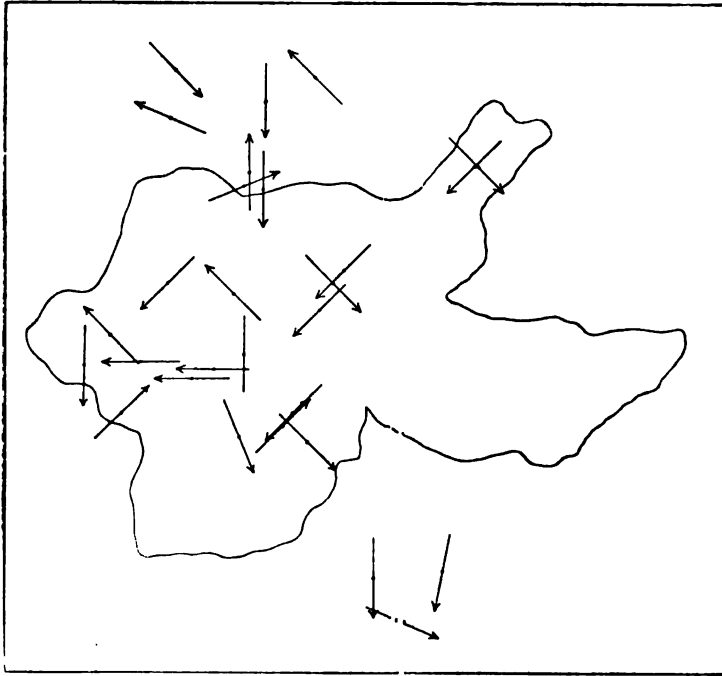


FIG. 16.—Apparent Directions of the Shock in Birmingham.

of the figure is too small to show also the directions of the streets in which the observations were made, but in the large map which I first prepared the relation is at once evident. In 11 cases, the angles between the direction of the shock and the street lie between 0° and $16\frac{1}{2}^\circ$, the average being $9^\circ.4$; in 11 others, they lie between 70° and 90° , with an average of $78^\circ.4$; while, in the remaining five, the angles lie between 54° and $66\frac{1}{2}^\circ$. As a general rule, then, the apparent direction of motion is perpendicular to one of the two principal walls of the house in which it was observed.

Discordant as the estimates of direction appear to be, they are not

distributed altogether at random. If the earth-wave arrived in a definite direction at any place, we should expect the impression of that direction to be more marked in a building whose principal walls are parallel and perpendicular to it, than in one obliquely placed, and consequently that more observations of direction would be made in houses of the former situation than in those of the latter. If, then, a large number of observations were made within an area whose linear dimensions are small compared with its distance from the centre, and in which there are streets in many different directions, the average of all the apparent directions of the shock should coincide approximately with the true direction of the earth-wave. In the absence of seismographic evidence, we are of course unable to decide what the true direction is, but if the average direction in several different counties should agree in pointing nearly to the centre, then it is highly probable, not only that the earth-wave did proceed along definite lines, but that it travelled along those lines all the way from the focus.

TABLE X

MEAN DIRECTION OF SHOCK

County.	No. o Obs.	Mean Direction of Shock.	Direction of Centre of County from Epicentre.	Difference.
Gloucester	37	E. 35° S.	E. 43° S.	8
Worcester	37	E. 21° N.	E. 31° N.	10
Shropshire	17	N. 17° E.	N. 2° W.	19
Somerset	14	S. 3° E.	S. 6° W.	9
Wiltshire	18	S. 25° E.	S. 31° E.	6
Berkshire	10	E.	E. 33° S.	33
Warwick	11	E. 25° N.	E. 22° N.	3
Birmingham	37	E. 39° N.	E. 41° N.	2
Stafford	26	N. 29° E.	N. 26° E.	3
Cheshire	17	N. 11° W.	N. 2° W.	9
Devon	10	S. 29° W.	S. 28° W.	1
Hampshire	9	S. 25° E.	S. 39° E.	14
Surrey	10	S. 41° E.	E. 30° S.	19
London	21	E. 21° S.	E. 19° S.	2
Hertford	9	S.E.	E. 9° S.	36
Buckingham	9	E. 15° S.	E. 12° S.	3
Northampton	10	N. 31° E.	E. 13° N.	46
Leicester	10	E. 5° N.	E. 32° N.	27
Yorkshire	11	N. 25° E.	N. 23° E.	2
Lancashire	29	N. 5° W.	N. 2° E.	7
Carnarvon	9	W. 39° N.	N. 42° W.	9

In calculating the average direction for each county, I have supposed the direction along every line of motion to be outwards from the centre, except in those cases where the apparent motion was perpendicular to the line joining the centre of the county to the epicentre. The average directions for 21 counties (including London

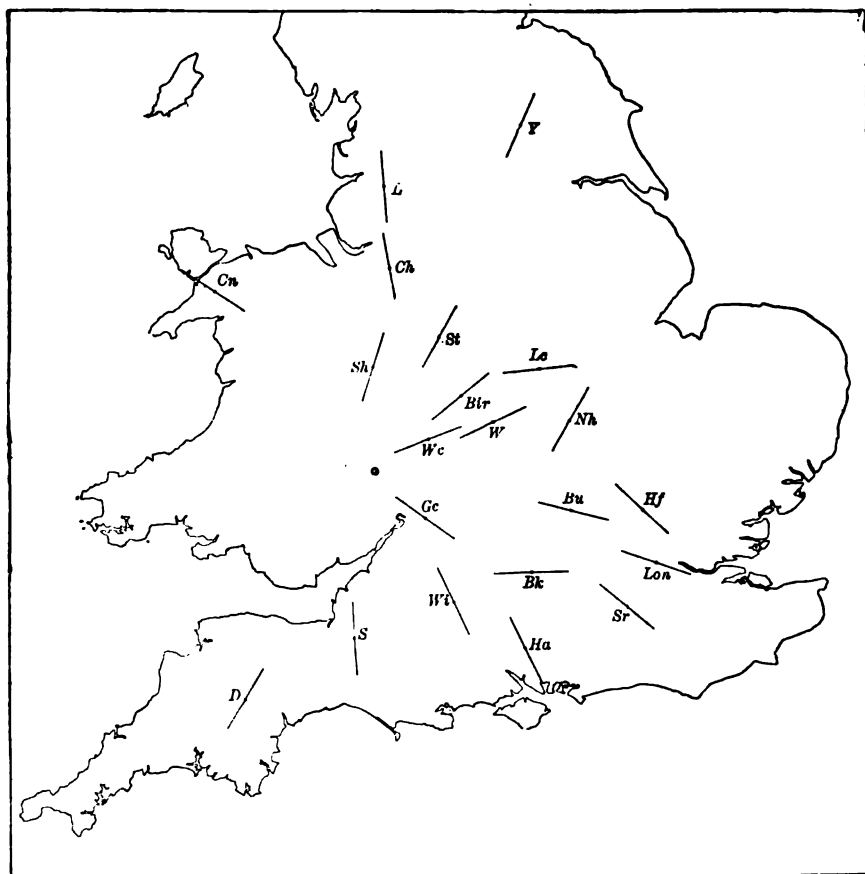


FIG. 17.—Mean Direction of the Shock.

and Birmingham) are given in Table X., Herefordshire being omitted for obvious reasons, and several other counties owing to the small number of observations made in them. The last two columns of the Table give the direction of the centre of the county from the epicentre, and the angle between this line and the mean direction of the shock. Fig. 17 illustrates this Table, the centre of the arrow

representing the mean direction being placed at the centre of the county.

The last column of the Table shows how very nearly the mean direction of the shock agrees in several cases with the direction of the centre of the county from the epicentre. The angle between them on an average is $12\frac{1}{2}^{\circ}$, while it is 3° or less in seven counties. When the deviation is considerable, the number of observations is small, or the county is near the epicentre and so subtends a large angle. The very close agreement in Devonshire is possibly accidental; but in London and Birmingham this can hardly be the case, and the testimony of the mean direction in these two cities is certainly very striking.

In order to avoid confusion in Fig. 17, I have not produced the lines of mean direction backwards towards the epicentre, but if this had been done, six of the lines would be seen to pass within five miles, and three others within two miles, of the centre.¹

We may therefore, I think, conclude from this analysis: (1) that the earth-wave travelled in approximately straight lines from the epicentre; and (2) that the average of a large number of observations of the direction made within a limited area will give a very close approximation to the true direction of the shock at the centre of that area.

Thus, while with a few isolated observations the "method of direction" is almost sure to fail, with a large number of observations closely grouped the position of the epicentre may be determined with a near approach to accuracy.

¹ The latter counties are Birmingham, Devon, and London; the former, Gloucester, Worcester, Warwick, Stafford, Buckingham, and York.

CHAPTER X

COSEISMAL LINES AND VELOCITY OF EARTH-WAVES

A "COSEISMAL LINE" is a line which passes through all places where the same phase of the earthquake was felt at the same instant, or, as Mallet defines it,¹ a line "in which . . . a wave-shell simultaneously reaches the earth's surface." If a series of such lines could be drawn accurately for consecutive equal intervals of time (say, minutes), it would show at a glance whether, and to what extent, the surface-velocity of the earth-wave varied in different directions and at different distances from the origin. Unfortunately, it has never yet been found possible to draw a series of coseismal lines with the same accuracy as isoseismal lines, and their absence from earthquake maps is anything but complimentary to our methods of popular time-keeping at the close of the nineteenth century.

During the last eight years, the records of horizontal and other pendulums have added greatly to our knowledge of the velocity of earth-waves proceeding from a distant origin; but we still know little with regard to the surface-velocity in the neighbourhood of the epicentre, and we know practically nothing about the velocity in the case of slight earthquakes like those which occur in this country.

A simple illustration will show that a few isolated time-records, if they are only correct to the nearest minute, are almost valueless for this purpose. In the Hereford earthquake, the time of occurrence at Hereford itself was 5.32, and at Wellington (Somerset) 5.34. Both these estimates are accurate to the nearest minute. But as, in the absence of other data, the time at Hereford (supposing it possible to read to a second) might be anything between 5h. 31m. 31s. and 5h. 32m. 29s., and that at Wellington anything between 5h. 33m. 31s. and 5h. 34m. 29s., it follows that the time-interval might be as great as 2m. 58s. or as small as 1m. 2s. The difference between the distances of Hereford and Wellington from the centre being 75 miles, we see that the mean surface-velocity might be as small as 2225

¹ *The Great Neapolitan Earthquake of 1857 (1862)*, vol. i. p. 10.

feet per second or as great as 6387 feet per second. It may be useful to know that there are such limiting values of the velocity, but otherwise the calculation possesses no interest.

In the present case, however, we have so large a number of time-records which are probably correct to within half a minute that a new method of dealing with them seems possible. We must reject all estimates earlier than 5.32, and, for England at any rate, all those later than 5.35 or 5.36, as well as a considerable number at 5.35 owing to the common tendency to quote the time to the nearest five minutes. When this is done, we are left with observations from 332 places which give the time to a minute without qualification, and from 82 others in which the word "about" or some similar expression is prefixed.¹ Of the former, 33 may be regarded as of higher value than the rest. They were obtained from signalmen and other careful observers who were in possession of Greenwich time or who compared their watches shortly afterwards with properly regulated clocks.

The method consists in indicating each place of observation on a map by a mark corresponding to the particular minute recorded. If all the records were absolutely correct, we should have a central area occupied by marks corresponding to 5.32, and this would be surrounded by a series of zones in which the times were respectively 5.33, 5.34, and 5.35. If, then, we draw curves separating the marks of different zones, we shall obtain coseismal lines corresponding to the times 5.32½, 5.33½, and 5.34½.

An ideal map of this kind would of course imply that the watches used were generally correct to within a second. In practice, therefore, the different zones must intrude on one another, and the coseismal lines have to be drawn in an average manner through the overlapping regions, special weight being given to the observations which appear to be of the greatest accuracy.

In Fig. 18, the coseismal lines, drawn according to this method, are shown as continuous curves; the isoseismals are indicated by dotted lines and are added for the sake of comparison. The coseismals must of course be regarded as approximations only; it is possible that they err considerably from their true form and position, but yet I think that they may be trusted so far that conclusions of some value may be deduced from them.

It will be seen at a glance that the coseismal lines are less elongated than the isoseismals, although the directions of their longer axes are approximately coincident. The reason for this appears to be that, while the intensity given is the maximum observed, the recorded time of occurrence belongs throughout to no definite phase of the movement, and this is a matter of some consequence when the total duration of

¹ Some of these, I believe, are more accurate than many which are recorded with greater confidence.

the shock may in places have been as great as 10 or 12 seconds. A few observers expressly mention that they took the time immediately the shock was over ; but this cannot generally have been the case, for

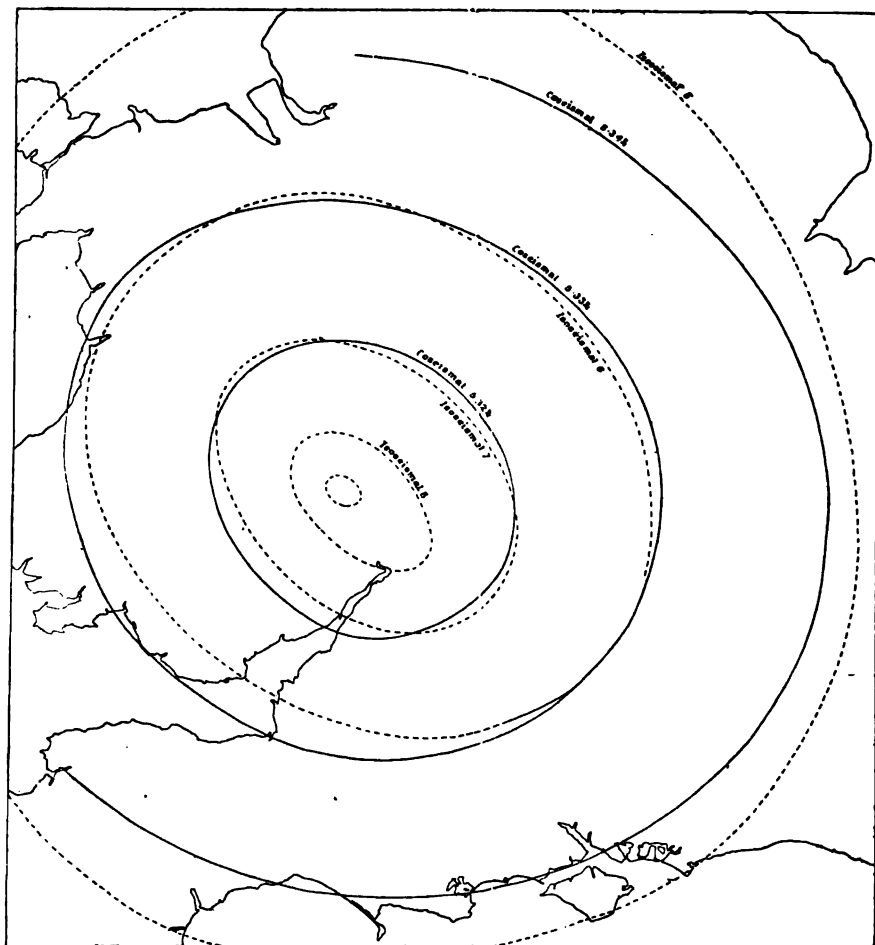


FIG. 18.—Map of Coseismal Lines.

then the coseismal lines would have been ovals with their longer axes at right angles to those of the isoseismals. Nor can the time as a rule have been that of the beginning of the shock, for then the coseismals would have been more elongated than the others. Judging from the form of the coseismal lines, it would seem that the epoch selected

(unconsciously perhaps) in the majority of cases was one not far from, and slightly preceding, that of the maximum intensity of the vibrations.¹

The dimensions of the coseismal 5.32½ are 76 miles from N.W. to S.E., and 64 miles from S.W. to N.E.; and those of the coseismal 5.33½ are 143 and 128 miles in the same directions. The coseismal 5.34½ is incomplete for three-eighths of its length, from S.W. to N.; its breadth from S.W. to N.E. is 197 miles.

The distances between the coseismal lines in eight directions are given in the following Table.

TABLE XI
DISTANCES BETWEEN COSEISMAL LINES

Direction.	Distance (in miles) between Coseismals.		
	5.32½ and 5.33½	5.33½ and 5.34½	5.32½ and 5.34½
N.	33	34	67
N.E.	33·5	35	68·5
E.	35	39·5	74·5
S.E.	31	37·5	68·5
S.	28·5	32	60·5
S.W.	31	33	64
W.	34	...	...
N.W.	36	...	...

Thus, the average distance between the first and second coseismals (5.32½ and 5.33½) is 32½ miles, or 32 miles for the first six directions. The average distance between the second and third coseismals for these directions is 35½ miles, and between the first and third 67½ miles. The mean surface-velocity between the first two coseismals is, therefore, 2882 feet per second; or 2816 feet per second, if we take the first six directions only. Between the second and third coseismals for the same directions it is 3095 feet per second. Probably, the best determination of the mean surface-velocity is that given for these directions between the first and third coseismals, namely, 2955 feet per second (or 0·90 km. per second).

There is an apparent increase in the mean surface-velocity from 2816 to 3095 feet per second during the two successive minutes. This, if it were correct, would agree with the results of some recent investigations. I wish I could feel that sufficient reliance might be

¹ The cause of this particular selection is probably an over-estimate of the duration of the shock.

placed on the accuracy of these coseismal lines to justify our accepting such a conclusion in this case.

We can now determine approximately the time at which the earthquake was felt at the centre. The distance of this point from the south-west side of the first coseismal is a little over 28 miles. To traverse this distance at the rate of 32 miles a minute would require 53 seconds, but the surface-velocity near the epicentre being very great, the time of transit would be somewhat less than this. The time at the centre must therefore have been later than 5h. 31m. 37s., say, about $5.31\frac{3}{4}$.

CHAPTER XI

MISCELLANEOUS PHENOMENA

Connexion between Geological Structure and the Intensity of the Shock

As the experience of many earthquakes has shown, the general effect of geological structure is that the shock is felt more severely on soft than on hard ground. The difference is clearly shown by the records of two similar seismographs at Tokio during the earthquake of June 20, 1894. One of these instruments is erected in the University observatory, which is situated on hard chalk and in an elevated part of the city; the other in the observatory at Hitotsubashi, where the ground is low and soft. At the former the maximum horizontal displacement and acceleration were 73 mm. and 444 mm. per second per second respectively; at the latter, 130 mm. and about 900 mm. per second per second.¹

The evidence obtained during the Hereford earthquake leads to a similar conclusion, though without throwing any fresh light on the subject. I had hoped that the large number of observations recorded in Birmingham and the neighbourhood would have allowed the detailed tracing of one or more isoseismal lines. Such graphical illustrations of the variation of intensity within a small area would have been of considerable interest; but the intensity at Birmingham was 6, and the boundary between the tests for this and the intensity below is one that requires a moderate light for its observation, and thus the records are of little service for this purpose.

At first sight, some observations appear to indicate that part of the variation in intensity is due to difference of altitude. For instance, at Fownhope, near Hereford, houses built on rock or high ground escaped, while those on low ground were damaged. At Bangor Miss Grace Ellis writes: "As far as I have asked, the people residing on the hills in this neighbourhood did not feel the shock, while those residing in the hollows invariably had done so." At Gainsborough the shock

¹ Prof. F. Omori, *Boll. della Soc. Sismol. Ital.* vol. 2, 1896, pp. 182-183.

was felt less strongly than in the lower ground in the Trent valley. But, in all these cases, it seems probable that the effect was due chiefly to the alluvial or softer character of the rock composing the low-lying districts.

The effect of geological structure is well illustrated by the observations from Great Malvern, which lies just outside the isoseismal 8 and is about 15 miles from the centre. The town is traversed by the great fault which skirts the eastern side of the Malvern Hills, so that part of it is built on the syenite which forms the hills, and part on the Keuper beds of the plains below. On the latter, as I am informed by Mr. J. G. R. Powell, who made many inquiries, the shock was felt with greater severity than on the harder rocks of the hills.

Again, there can be little doubt that the intensity at Deganwy, in Carnarvonshire, should be estimated as 6, although the place lies 15 miles outside the corresponding isoseismal. The house in which the observation was made is solidly built, with stone walls $2\frac{1}{2}$ feet thick, and the abnormal intensity was in all probability due to the fact that the foundation of the house is entirely in sand.

The most detailed observations on this subject are those which were collected by Mr. E. Greenly from Anglesey and the neighbourhood of Bangor; and I am greatly indebted to his kindness for the following valuable note, in which he has discussed the records from this district.¹

Variation of Intensity in the Bangor-Anglesey District, by Mr. E. Greenly, F.G.S.—"The rocks composing the district, as may be seen in the maps of the Geological Survey, are of a very variable character; zones of hard crystalline schists, and ancient lavas and tuffs, alternate with others of softer Ordovician shale and Carboniferous Limestone and sandstone several times over in the space of a few miles.

"The reports show clearly that the intensity of the shock diminished rapidly in a north-west direction, the last reliable records having been from Trescawen, near Llangwyllog, and Aberffraw on the west coast. All replies from observers situated farther to the north-west have been in the negative. In the country to the south-east, on the contrary, it appears to have been generally felt. Therefore, the south-east portion of the Bangor-Anglesey area, a zone about 14 miles wide from south-east to north-west, seems to have been a region in which the sensible effects of the shock were dying out.

"Now, allowing for gradual decrease of intensity as shown, the varying reports seem to show that, within this zone, the shock was felt most powerfully in houses standing upon the Carboniferous and Ordovician rocks; less so in those upon the hard volcanic series of Bangor; and least of all in those upon the schistose complex of Anglesey.

¹ Mr. Greenly's complete report on this subject will be published in the next volume of the *Transactions* of the Edinburgh Geological Society.

"Were it possible to draw the isoseismals with accuracy, we should probably find them sharply incurved around the areas occupied by the last-named rocks, or inliers even occurring of outer and lower isoseismals.

"Moreover, all reports of the shock having been felt within the schistose areas are from observers situated close to the margins of those areas, i.e. to junctions with Carboniferous or Ordovician rocks. General reports from the heart of the central area seem to show that it was scarcely felt at all, while the reports from Tregaian and Bodorgan are near junctions. Much more remarkable is the immunity of the south-east region, throughout the heart of which I cannot find that any shock at all was felt, while from stations on its *outer* edge considerable disturbance is reported. Moderate disturbance is reported from the margin of the Straits, again near the margin of the schistose complex; and in 'Menai Bridge,' a large village or small town where I know many people, I have only been able to find one person who felt anything,¹ although from a house at the Carnarvonshire end of the bridge, on the Carboniferous Limestone, a very decided shock is reported.

"It is to be noted that not only are the Carboniferous and Ordovician rocks probably far less elastic than the crystalline schists, but that they are also (as about Beaumaris) much more deeply covered, as a rule, with Boulder Clay.

"In the Bangor area itself, although the shock was felt upon the hard volcanic series, there is a general agreement among all persons that it was far more strongly felt in Lower or Old Bangor, i.e. on (or within a few yards of the boundaries of) the faulted wedge of Ordovician shales. It seems also to have been more felt upon the Carboniferous rocks near the Straits, so far as I can gather, than upon the old volcanic series."

Observations in Mines

It has long been known that an earthquake may be severely felt on the surface and yet pass unnoticed by persons in mines below. Even at the bottom of a pit a few feet deep, the shock may be sensibly weaker than at the surface. But it appears, from the interesting experiments made by Messrs. Sekiya and Omori, that this is not the case for all earthquakes. For slight shocks, they find, "there is no practical difference between the surface and underground observations; for the principal undulations of severe earthquakes this difference may exist, but not to any marked degree; but for the small quick vibrations the difference is considerable." The ripples, in fact,

¹ "It is just possible that a very thin strip of Ordovician shales passes near this house."

seem to be in great part smoothed away in the pit, and it is thus possible that, with severe earthquakes, "there might be less destructive action in deep pits than on the free surface."¹

As the following records show, the Hereford earthquake was observed in mines at some distance from the epicentre.

1. Trafalgar (near Mitcheldean, 14 miles from the centre).—"Some three or four night-inspectors were in the underground workings of the Trafalgar Colliery . . . at the time. They were much alarmed and thought the workings were going to tumble about their ears. One man told me he heard the sound first coming in the distance like the rolling of thunder, it gradually came nearer, and then the trembling came and the earth seemed to be in throes. The rumbling appeared to pass on and the trembling died down. This was in the north-west part of the pit workings, which are very extensive. . . . In the south-east part, another man heard much slighter noise and felt much slighter shocks. . . . I cannot ascertain that the earthquake caused any damage or falls in the workings" (Mr. F. Brain, C.E., General Manager).

2. Parkend (near Lydney, 19 miles from the centre).—"In the interior of the colliery, three-quarters of a mile from the shaft-bottom, and about 900 feet below the surface, a collier was working alone, no living being or animal within the above distance of him. At the time of the earthquake, he heard a rumbling noise, as though a train of colliery trams was being rolled along the tramway, some distance away, and, knowing this could not be, he was very scared" (Mr. T. H. Deakin, communicated by Prof. J. Milne).

3. Whitecroft (near Lydney, 20 miles from the centre).—"There are two pairs of pits belonging to the colliery under my management, about three-quarters of a mile apart. One is working a seam of house coal at a depth of 100 yards. This seam is covered over with 15 yards of blue shale. Scarcely any sound was produced in this seam of coal, but the men working in the mine were alarmed by a trembling sensation and crumbs of shale showering from the roof and sides. The other pits are working a steam coal 140 yards deep. This seam rests upon and is covered over with dense and compact beds of sandstone rock many yards thick, and the sound produced throughout this pit in the underground workings was of a rumbling, grating, grinding character. But, in both cases, the workmen hurriedly left their work to ascertain the cause of the disturbance" (Mr. C. Cooke).

4. Madeley (near Ironbridge, 42 miles from the centre).—"An intelligent miner . . . who was down Hamberton pit attending to the fires, says he heard a great noise, and thought one of the loaded waggons of coal had got loose and was running down the incline. He was about 300 yards from the surface and not far from a fault with

¹ "Comparison of earthquake measurements made in a pit and on the surface ground," *Japan Seismol. Soc. Trans.* vol. 16, 1892, pp. 19-45.

a downthrow of 60 yards" (Mr. J. Randall, communicated by Mr. E. S. Cobbold).

5. Wattstown (Rhondda Valley, about 44 miles from the centre).—"Many of the miners engaged on the night-shift at the colliery state that a rumbling noise was heard in the underground workings" (*Western Mail*, Cardiff, Dec. 18).

6. Chasetown (near Walsall, 54 miles from the centre).—"A friend of mine, who was down a pit (two miles N.N.W. of Chasetown and a little below sea-level), heard a noise which sounded like a number of coal-tubs running, but did not feel any shock" (Mr. G. F. Reader).

7. Derbyshire.—"In some of the mining districts of Derbyshire, the greatest alarm was experienced. Miners who were at work on night-shifts were terrified, concluding that the vibration was the result of an explosion" in the neighbourhood (*Daily Chronicle*, Dec. 18).

At Rugeley in Staffordshire (58 miles from the centre), the Rev. A. Moncrief "made many inquiries from miners who were at work in pits at the time, and all profess to have been ignorant of the occurrence." At the Newstead Colliery near Nottingham (94 miles from the centre), the Lady Helena Carnegie informs me that "the workers above ground were seriously alarmed by the shock . . . but in the pit not a tremor was felt, nor anything unusual noticed. The pit is 430 yards deep." With regard to mines in Lancashire, Mr. Mark Stirrup, F.G.S., writes, "I have made many inquiries among the managers of coal-pits around Manchester, Bolton, and Wigan . . . and find, as far as I can ascertain, that nothing of any vibration or disturbance was noticed in the workings."

It thus appears that the mines in which the earthquake attracted attention lie within a radius about one-third of that of the isoseismal 4. It is not certain whether the vibration referred to in the record from Derbyshire was sensible as shock or sound; but, on the whole, it would seem that in the more distant mines the shock was imperceptible and that only the sound was observed.

Effects on Surface-waters

A few observations on the effect of the earthquake on rivers, etc., are worth recording here. Vessels at Gloucester Dock were rocked to and fro, and many of the crews are said to have gone on land under the impression that the ships were sinking. Mr. R. W. Malsom was walking through a wood near Ruardean in Gloucestershire, and, being close to a spot where two streams meet, he noticed that the water seemed to stand still at the time of the shock. A resident of Pendock, in Worcestershire, was on his way to work, and, at the instant when he felt the shock, he was near a long pool which was nearly full, and he distinctly saw that the water was very much disturbed. During

the shock, the river Severn at Worcester "suddenly surged and angrily foamed up to the level of its banks, subsiding to its former level" on its cessation.¹ Mr. J. G. R. Powell, of Great Malvern, informs me that people coming in from Bredon remarked that the river Avon seemed to boil. At Cradley, $2\frac{1}{2}$ miles west of Malvern, "the water in the moat surrounding a farmhouse, . . . once a fortified building, was frozen, and it was noticed by the inmates that the water underneath had been forced up to the upper surface of the ice and had flowed over it to some distance from the edges" (Rev. T. A. Ayscough). Again, a shepherd was crossing the canal bridge at the east end of Leamington, and, although he felt nothing, he said that, at 5.35 A.M., the ice in the canal broke with a loud report.

Effects on Underground-water

I have received only two notices of any change in the circulation of underground water. The first, for which I am indebted to Mr. C. Cooke, is from Whitecroft, near Lydney, in Gloucestershire. It consists of the weekly record of water-pumping at the colliery referred to on p. 279, as bounded above and below with compact rocks. It will be seen that there is an extraordinary increase of water on the days following the earthquake. "Such an increase," Mr. Cooke remarks, "has not previously occurred under ordinary conditions. There is always an increase from November to February, but it is always gradual. In this instance it is sudden. Is it possible that the joints and fractures in the rocks have been slightly opened by the disturbance allowing a freer inflow for the water?"

TABLE XII

PUMPING SPEED AT WHITECROFT COLLIERY, WEEK ENDING
DEC. 19, 1896

Date.	Day.	Rainfall.	Ram Cornish Pump, 21" diam.	Bucket Auxiliary Pump, 16" diam.
13	Sun.	0.42 in.	5 $\frac{3}{4}$ strokes per min. for 24 hours	6 strokes per min. for 5 hours
14	Mon.	0.18 "	5 $\frac{1}{2}$ " "	6 " 7 "
15	Tu.	...	5 $\frac{3}{4}$ " "	6 " 7 "
16	Wed.	...	5 $\frac{3}{4}$ " "	6 " 8 "
17	Th.	...	5 $\frac{1}{2}$ " "	6 " 8 "
18	Fr.	...	6 " "	9 " 24 "
19	Sat.	...	6 " "	9 " 24 "

¹ *Nature* vol. 55, 1896, p. 179.

The other record comes from Droitwich, and has been kindly communicated to me by Mr. T. P. Baylis, Borough Surveyor. Between 5 and 6 A.M. the register of a waste-water meter at that town showed an increased flow of 700 gallons per hour.

Miscellaneous Observations

In this section, I have collected several observations relating to real or apparent movements of the ground, trees, etc. That the movements were in part real, is evident from an observation made at Rendcombe in Gloucestershire, where the hoar-frost, with which the trees were thickly encrusted, was all shaken down in a moment. Also, to an observer in a wood near Ruardean in the same county, "the trees seemed to clash together, then tear one another apart." Some of the movements recorded in the next paragraph may, however, be in part real, but partly also apparent and due to the motion of the observer.

A man going to his work at Avenbury, in Herefordshire, saw "the trees and hedgerows all bowing down and quivering." Trees were also seen to shake and quiver by persons in the open air at Bishops Cleeve (Gloucestershire), Pulverbach (Shropshire), and Ashley (Staffordshire). The driver of a stationary engine near Colwall, in the tunnel under the Malvern Hills, "felt the shock and saw his engine moving rapidly and attributed it to himself becoming giddy." A man crossing a field at Kingstone (Herefordshire) "saw the rising and falling of the ground." Another going to work at Weston Beggard, in the same county, saw the church tower sway and heard the bells jangle. At Cheltenham, according to one observer, "the floor (seen by gaslight) seemed to heave up between the door and window from west to east, the line of the bend running from north to south." Looking down from a hill upon the village of Flaxley, in Gloucestershire, a man "thought he saw the tiles on the roofs of the houses shake, like the leaves on a tree when the wind passes. . . . The next moment the ground shivered beneath him." At Bromsgrove, an observer lying on his back distinctly saw the west end of his room upheave twice. Lastly, at Droitwich, a night-watchman at a substantially-built house, on looking towards it, saw that the turrets were shaking.

The evident magnitude of some of these movements seems, however, to show that they are partly apparent as well as real, and the correct explanation is probably that given by Dr. J. Marshall. "It is well known," he says, "that, when the head is moved swiftly to one side and back again to a vertical position, upright objects, seen in front, appear to shift from their vertical position in an opposite direction, and then back again. . . . A similar apparent displacement of objects, though in a vertical direction, occurs when the head is

nodded backwards and forwards. . . . Lastly, if the observer is in a horizontal position, as in bed, for example, a sudden rolling over of the head to one side and back again produces like phenomena." During an earthquake, the observer's head is suddenly disturbed in a given direction, and "an opposite involuntary movement instantly occurs in order to restore the previous condition of things." Thus, real movements may be exaggerated "by the *subjective* impressions due to movements occurring in the observer's own optical apparatus."¹

Feeling of Nausea

A feeling of nausea is a not uncommon sensation during strong earthquakes, and is reported by 17 observers, chiefly, but not entirely, by ladies. As a rule, the feeling was only temporary, but with one observer at Worcester (21 miles from the centre) it lasted all day. In two cases, near Cowarne (7½ miles) and at Malvern (15 miles), persons are said to have been actually sea-sick, but I have not this information direct from the sufferers themselves. The feeling was noticed at considerable distances from the centre, *e.g.* at Weymouth (100 miles), Walton-on-Thames (106 miles), Richmond (Surrey, 110 miles), London (113 miles), and Bradford (Yorkshire, 125 miles).

Effects on Animals

The effects on animals were simply those of alarm at the occurrence of a sudden and unusual phenomenon.

At Bromyard (11 miles from the centre), horses were greatly frightened, "trembling in their limbs and shaking with fear." If in stables, they plunged, rushed backwards the length of the neck-tie, or tried to drag away from the manger. Cart-horses loose in fields galloped about and snorted with terror. At Tarrington (4 miles), a villager, bringing his master's horses from the field, was nearly trampled on by them; they crowded round in great alarm, and for days afterwards would not pass the spot without reluctance. Even as far as Reading (83 miles), a number of horses in the meadow "packed," and in a terrified stampede rushed for the shelter of the buildings.

Men milking cows at Down Hatherley (21 miles) during the earthquake report that the cattle evinced great fear and were much excited. At Worcester (21 miles), milch-cows trembled and seemed dazed; while at Rendcombe (34 miles), loose cattle in yards were seen to leap suddenly upwards as if electrified and then to scamper round the yard in evident terror.

Dogs of various kinds barked and howled piteously for several

¹ "The mode of observing the phenomena of earthquakes," *Nature*, vol. 42, 1890, pp. 414-416. See also a letter by Mr. Harold G. Dixon in the same volume, p. 491.

minutes after the shock. Near Ruardean (14 miles), sheep ran about as though chased by a wild beast. In other places, cats sprang up and rushed wildly about the house.

Pheasants are well known to be peculiarly sensitive to slight tremors, and have even been kept by a seismologist for the purpose of detecting earthquakes.¹ On the present occasion, they flew off with startled cries from the trees in which they roosted, or ran to and fro, crowing and evincing signs of great terror. An observer at Laysters, in Herefordshire (15 miles), remarks that "the covers on the estate seemed nothing but cackling of magpies and pheasants."

Poultry of all kinds were much upset by the earthquake. They flew down from their perches and showed signs of distress. Cocks crowed lustily at Ashley Green, Buckinghamshire (91 miles). A flock of ducks in a lake at Rendcombe (34 miles) quacked and took to flight, while the swans lifted themselves above the surface and beat the water noisily with their wings. At Aberdunant, in Carnarvonshire (88 miles), peacocks and peahens screamed out.

Smaller birds flew from the trees on which they were roosting with cries of alarm. At the Franciscan Convent at Woodchester, near Stroud (28 miles), one of the Sisters remarked a fluttering of small birds at the windows, the sound of which she at first mistook for hail. Thrushes, bullfinches, and other birds in cages fluttered about, beating themselves against the wires so violently as to lose feathers. It is said that, at Gloucester (21 miles), between thirty and forty dead sparrows and pigeons were picked up in the goods yard of the Great Western Railway Company;² and, at Norton in Worcestershire (30 miles), it is also reported that small birds were afterwards found dead upon the ground. Even at Luffenhall, in Hertfordshire (109 miles), a grey parrot in a cage placed on a table "screamed vociferously as though much frightened."

It has often been noticed that birds and animals show signs of distress a few seconds before an earthquake is perceived by human beings. Such effects are naturally attributed to the small tremors which precede nearly all large earthquakes.³ Dr. A. Cancani, who has studied this subject in connexion with Italian shocks, remarks, however, that animals fail to announce an earthquake when they are within the epicentral area, though they always do so at greater distances; and he infers from this that the small tremors travel with a greater velocity than the larger vibrations.⁴

¹ Prof. S. Sekiya, *Japan Seismol. Soc. Trans.* vol. 12, 1888, p. 4.

² *The Times*, Dec. 18, 1896.

³ Prof. J. Milne, F.R.S., "Note on the effects produced by earthquakes upon the lower animals," *Japan Seismol. Soc. Trans.* vol. 12, 1888, pp. 1-4.

⁴ "Sul così detto presentimento degli animali nei terremoti," *Boll. Soc. Sismol. Ital.* vol. 2, 1896, pp. 66-74. I think, however, that the phenomenon can be explained in another way, as in the case of the apparent outracing of the shock by the sound (see above, pp. 263-264).

The observations made during the Hereford earthquake on this interesting point are, I regret to say, partly inconclusive. There can be no doubt that in several cases birds were disturbed before the earthquake was perceived by man, but, by a strange coincidence, a bright meteor passed over the central part of the disturbed area from south to north at about the same time (see Appendix). In the epicentral district the meteor appeared after the shock began, but, farther north, it traversed Shropshire and the adjacent counties before the arrival of the earthquake-wave. Thus, it is possible that, with one exception, the meteor may be responsible for the prior perception of the shock by birds and animals.

The following are the observations alluded to. At Dormington, in Herefordshire (2 miles from the centre), "all animals were greatly disturbed during, after, and some say *before*, the shock." In this case, the effect can be attributed only to the earthquake, and it thus forms an exception to the law stated by Dr. Cancani, for Dormington lies within the epicentral area. At Bridgnorth, in Shropshire (36 miles), a number of white birds were seen flying in the air before the shock. Near Smethcote, in the same county (39 miles), "pheasants were in great commotion prior to the shock." Again, near Little Wenlock (43 miles), also in Shropshire, some men who were on their way to work say that "they saw a large meteor which woke up all the pheasants in the woods, as well as birds and other animals, and that they all made a perplexed noise."¹ Lastly, at Holt, in Denbighshire (72 miles), an observer, who was awake at the time, heard the pheasants in the woods making a noise, and this was followed by the sound which preceded the shock.

Another point of some interest is the relative sensitiveness to earth tremors of different birds and animals. One observer at Wimbledon (113 miles) went at once to the front door, and, when he opened it, a dog was barking violently next door, and a cow was bellowing in a neighbouring field. These effects do not appear to be clearly due to the earthquake. Omitting them, we find that cats were disturbed to a distance of 22 miles from the centre, but this is probably an under-estimate. Cattle felt the effects at a distance of at least 34 miles, horses at 83 miles, poultry at 91 miles. Dogs barked at Bournemouth (98 miles), Heavitree, near Exeter (99 miles), and at Luffenhall in Hertfordshire (109 miles). Small birds were frightened at Exmouth (104 miles), Bramfield in Hertfordshire (108 miles), and at Luffenhall; and pheasants crowded at Hertingfordbury in Hertfordshire (111 miles), Plas Tregayan in Anglesey (111 miles), Oxted in Surrey (127 miles), and Brenchley in Kent (145 miles).

¹ These men did not feel the shock, and they would therefore naturally attribute the disturbance of the pheasants to the meteor.

CHAPTER XII

MINOR SHOCKS

IN the history of an earthquake-series, the minor shocks which precede and follow the principal shock play a part of far greater importance than their relative weakness would seem to indicate. The former represent the preparations for the chief displacement; the latter are the consequences of that displacement, the indices of the gradual, but intermittent, return to equilibrium of the disturbed mass. The careful study of a complete earthquake-series should thus exhibit to us the process by which faults grow.¹

Unfortunately, the observation of accessory shocks is rendered difficult as a rule by their comparative slightness; and in the case of the preliminary shocks, by the inexperience and want of preparation of the observers. After the principal shock, the attention of interested observers is generally on the alert, and then the danger is one of including too much rather than too little.

Of the twelve undoubted accessory shocks of the Hereford earthquake, nine (A—I) occurred before, and three (J—L) after, the principal shock, the times of the first eleven lying between limits about seven hours apart.

I regret that, with three exceptions, the records are insufficient to determine the positions of the epicentres with any approach to exactness. The three cases referred to are described below; for the remainder, it is difficult to add anything to the accounts given in Chapter III.

Map of the Minor Shocks.—The dotted lines in Fig. 19 represent isoseismal lines of the principal earthquake. It is not possible in any case to draw the complete boundary of the disturbed area; but portions of the boundaries for two shocks (those denoted above by the letters E and K) are indicated by continuous lines, and the probable positions of the remaining parts of the boundaries are shown by

¹ See, for instance, a paper "On the distribution in space of the accessory shocks of the great Japanese earthquake of 1891," *Quart. Journ. Geol. Soc.* vol. 53, 1897, pp. 1-15.

broken lines. The disturbed area of the first shock (A) coincided so nearly with that of the fifth shock (E) that I have not drawn its boundary on the map. In order to avoid overcrowding of names, the places of observation for these three shocks are not shown, only those being marked where the remaining shocks were perceived.¹

TABLE XIII

LIST OF MINOR SHOCKS

Time of Occurrence.	Intensity.	Number of Accounts.	Number of Places of Observation.	Number of Observers who	
				felt the Shock.	heard the Sound.
A. Dec. 16, about 11.0 or 11.30 P.M.	Prob. 4	13	12	8	4
B. Dec. 17, " 1 A.M.	3	4	4	2	3
C. " " 1.30 or 1.45 A.M.	3	3	3	2	2
D. " " 2 A.M.	4	9	9	7	2
E. " " 3 A.M.	Prob. 4	21	20	20	3
F. " " 3.30 A.M.	Prob. 3	7	7	7	3
G. " " 4 A.M.	4	8	6	7	1
H. " " 5 A.M.	4	6	6	4	3
I. " " 5.20 A.M.	?	4	4	4	1
J. " " 5.40 or 5.45 A.M.	Prob. 3	7	7	4	3
K. " " 6.15 A.M.	Prob. 3	10	10	8	2
L. July 19, 1897, 3.49 A.M.	4	10	5	9	8

Minor Shock A. Dec. 16, about 11.0 or 11.30 P.M.

The accounts of this, the first undoubted shock, are insufficient to determine the boundary of the disturbed area except in the eastern half, where it coincides very nearly with that of the fifth shock (E). Towards the north-west, the boundary probably does not reach so far as that of the latter shock by about five or six miles, while towards the south-west it may extend as much as four miles beyond. The approximate dimensions of the disturbed area are thus 97 miles in length from north-west to south-east, 83 miles in breadth, and 6300 square miles in area. The focus was apparently situated between the two foci of the principal earthquake, and partly coincided with them.

St. Michael's Cathedral Priory, which is mentioned three times in the records in Chapter III., is situated in the parish of Clehonger.

Minor Shock E. Dec. 17, about 3 A.M.

As already mentioned, the boundary of the disturbed area of this shock is incomplete, there being no observations from the counties of Brecon and Glamorgan. If, however, we continue the line

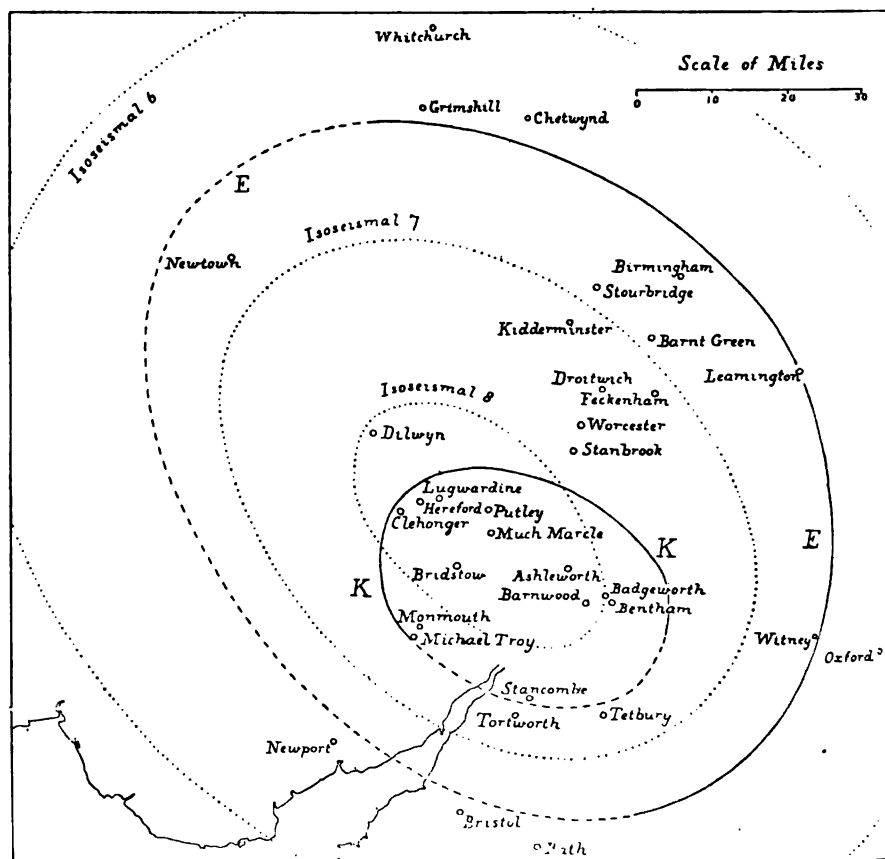


FIG. 19.—Map of Minor Shocks.

towards the west in what appears to be its most probable course, we obtain a curve 104 miles long, 79 miles broad, and containing about 6400 square miles. The distance between the boundary and the isoseismal 7 of the principal earthquake is 6 miles on the south-west side and 15 miles on the north-east. The boundary is thus not concentric with any of the isoseismals, but it occupies approximately

the position that would be taken by an isoseismal of intensity between 7 and 6. We may therefore infer that this shock and the principal earthquake were caused by slips along the same fault and in about the same region of the fault. Also, as there is no evidence of discontinuity in the vibrations of the minor shock, it is probable that the focus was continuous and occupied the space intervening between the two foci of the principal earthquake, as well as part or the whole of both these foci.

Minor Shock K. Dec. 17, about 6.15 A.M.

With one exception, all the places where this shock was observed lie in the counties of Hereford and Gloucester. Here, again, only about half of the boundary of the disturbed area can be drawn, the conjectural part being indicated by a broken line. The curve so drawn is 41 miles long, 27 miles broad, and includes an area of about 870 square miles. Allowing for the probable inaccuracies of the curve, it would thus appear that the shock was connected with the same fault as the principal earthquake, and that its focus coincided approximately with the south-east or Ross focus of that earthquake.

In the case of the remaining minor shocks, the evidence is of course insufficient to establish any connexion with the originating fault of the principal earthquake. If we may assume, from the proximity of time and place of occurrence, that this connexion exists, then it would appear probable that the last shock of all (L) had a focus approximately coincident with the Ross focus. With regard to the others, no more than a rough guess can be made. The focus of the shock J was possibly situated in the central region between the two foci, and the foci of the rest (with perhaps the exception of the shock I) may have coincided with the Ross focus.¹

Sound-phenomena of the Minor Shocks.—In every case, as will be seen from Table XIII., the minor shocks were accompanied by sound, which was generally a faint distant sound, frequently resembling that of a gust of wind. Sound-comparisons are made in seventeen cases, which are distributed among the types enumerated in Chapter VIII. as follows:—Passing waggons, trains, etc., 4; thunder, 1; wind, 6; fall of loads of stone, 1; fall of heavy bodies, 0; explosions, 2; miscellaneous, 3.

¹ It is just possible that the shocks F and G were not connected with the principal fault at all. Referring to the map (Fig. 19), it will be seen that the places of observation have a roughly linear distribution, and in no cases are they very distant from the line of the great fault which skirts the eastern side of the Malvern Hills.

CHAPTER XIII

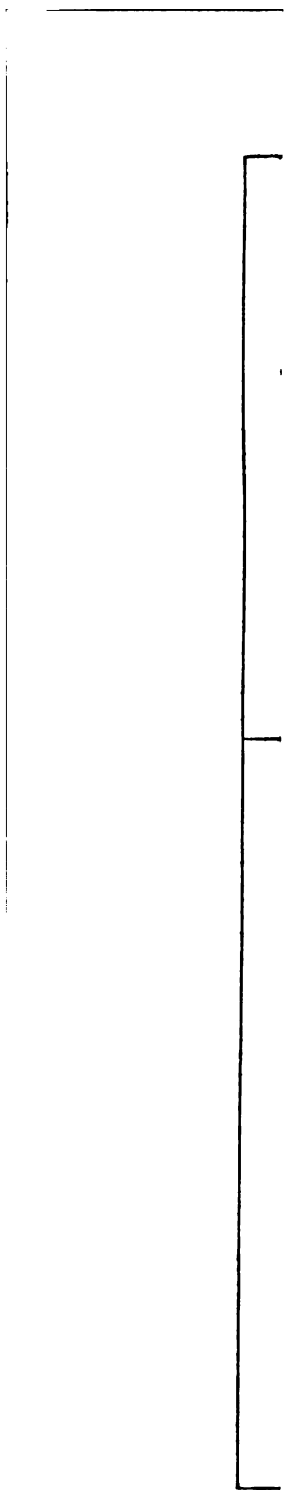
ORIGIN OF THE EARTHQUAKES

THE evidence with regard to the principal earthquake leads to the following conclusions: (1) That the observed phenomena are consistent with the theory that the earthquake owed its origin to a slip along a fault many miles in length; (2) that the average direction of the fault is very nearly north-west and south-east, or, more accurately, between W. 44° N.-E. 44° S. and W. 42° N.-E. 42° S. and its hade towards the north-east; and (3) that the fault-line passes a short distance to the south-west of Hereford, the exact distance being doubtful, but probably not much less than one mile or more than three miles. A possible course (AA) of the fault-line is shown on the map in Fig. 20, though it should be remembered that the evidence leading to this assignment (see p. 225) is not very strong.

Geology of the Epicentral District

The approximate position of the originating fault being thus ascertained from the seismic evidence, we may now examine how far it is in accordance with the known geological structure of the district. Fig. 20 contains a map of part of the epicentral area, reduced from that made many years ago by the Geological Survey.¹ The broken line AA, drawn W. 43° N.-E. 43° S. through a point one mile south-west of Hereford, represents the average course of the fault-line as determined above. The other broken lines show the faults which are traced upon the Survey map. It is thus evident that none of these, at least so far as drawn, corresponds with the suggested fault. The latter, however, lies within the area covered by the Old Red Sandstone, an area which has never been investigated with thoroughness by modern stratigraphical methods. To trace the faults which

¹ I am indebted to the Director-General of the Geological Survey for permission to make use of the map. It should be mentioned that some of the details contained in the original are, for simplicity, omitted.



intersect the Sandstone, it would be necessary to study the beds carefully zone by zone, and this has not yet been attempted. The absence of faults upon the Old Red Sandstone area of the map is therefore no proof of their non-existence. It does not in any way weaken the conclusion obtained from the study of the earthquake. In the meantime, we have rather to trust to seismic evidence for any light that may be shed on the direction and hade of the faults.

One of the most interesting features in the geology of the epicentral district is the well-known Woolhope anticlinal, by which the Silurian beds are brought to the surface through the sheet of Old Red Sandstone. The anticlinal axis runs approximately north-west and south-east, and is thus roughly parallel to the isoseismal axes of the principal earthquake. According to the Geological Survey section¹ of the anticlinal dome, the Silurian beds at first dip gently on either side from the axis, but more steeply near the south-west boundary of the area; while, on both sides, the Old Red Sandstone overlies the Silurian rocks conformably. There might thus apparently be some conflict between the seismic and the geological evidence. But this is not necessarily the case, for the section referred to is drawn through the northern end of the anticlinal dome, and so just misses a more complicated district along the south-west margin. Professor Lapworth has pointed out to me, that a peculiar thinning out and occasional disappearance of some of the Silurian beds on the south-west side of the anticlinal (as compared with those on the north-east side) is suggestive of a north-west and south-east fault or rapid flexure at or near the junction of the Old Red Sandstone and the Silurian strata, at any rate for a distance of about six miles, measured from near Fownhope towards the south-east. This boundary fault or flexure runs nearly parallel to the axis of the Woolhope anticlinal, and therefore also to the fault suggested by the seismic evidence.

One is naturally led to inquire whether a slip along a fault in this suggested position, if there be one, may not have been responsible for the principal earthquake. The village of Fownhope, where a good deal of damage was done, lies about a hundred yards to the south-west of the boundary; and a line drawn north-west from Fownhope would pass near Hereford and Dinedor, where the amount of damage was also relatively considerable. But, if this were the originating fault, the intensity would have been greatest at some distance to the north-east of the fault-line; and, on this account, I think that a slip along a boundary-fault cannot be invoked as the origin of the earthquake.

But only a few miles to the south-east of the Woolhope anticlinal, and almost in the same line with it, there is a second anticlinal, that of May Hill. This is a triangular area, and is known to be bounded on

¹ Horizontal Sections, Sheet 13, Section 2.

all three sides by faults. That on the north-east side (marked BB on the map) has an average north-west and south-east direction, and, if it be a normal fault, it must have to the north-east. It thus satisfies one, and perhaps two, of the conditions determined by the seismic evidence. Moreover, if it were continued through the Old Red Sandstone towards the north-west, but bending at first a few degrees more to the west, it would pass through a point one mile south-west of Hereford. It is worthy of notice that both this fault and another nearly parallel to it, about half a mile farther north-east, stop, according to the Survey map, at the points where they enter the Old Red Sandstone. Remembering how difficult it is to trace faults through the latter formation, it is therefore not unreasonable, I think, to infer a connexion between a continuation of this fault and the recent Hereford earthquakes.

Seismic History of the Hereford District

The earthquakes described in this report may be regarded as forming a chapter in the seismic history of the Hereford district. But our knowledge of the chapter can hardly be considered as complete without some reference to previous earthquakes which have originated within and near the same region. By far the most important of those which have occurred during the present century is the earthquake of October 6, 1863, the one already mentioned (p. 224) as approaching most closely to the earthquake of 1896, so far as regards the extent of the disturbed area.

For the investigation of this earthquake, we are indebted to Mr. E. J. Lowe, F.R.S.¹ His work having been carried out some years before the invention of the Rossi-Forel scale of seismic intensity, the details published in his report are not sufficient to allow the isoseismal lines to be drawn. Mr. Lowe has, however, marked the boundary of the area within which the shock was most strongly felt, and this is shown by the continuous line in Fig. 21; the broken lines representing the isoseismals 8 and 7 of the earthquake of 1896. Buildings were damaged at Hereford and a few other places, but the amount of damage was apparently far less than on the more recent occasion. The shock seems to have been most violent at Garway. It is not quite certain that the curve drawn by Mr. Lowe is an isoseismal line, but, assuming this to be the case, the corresponding intensity is probably not far from 7 of the Rossi-Forel scale. The curve is 67 miles long and 38 miles broad. Its longer axis is directed north-east and south-west, and is therefore at right angles to the axis of the isoseismal 8 of the earthquake of 1896.

¹ "History of the earthquake of 1863, October 6th," *Brit. Meteor. Soc. Proc.* vol. ii. 1865, pp. 55-99.

Five years later, on October 30, 1868, another, but less violent earthquake occurred in the same district; but, unfortunately, no one undertook its investigation. The only account with which I am acquainted is a very brief one by Mr. G. J. Symons, F.R.S.¹ On the map which he has drawn, 74 places of observation are shown, and, so far as we can judge from them, it would appear as if the central part of the disturbed area coincided approximately with that which is

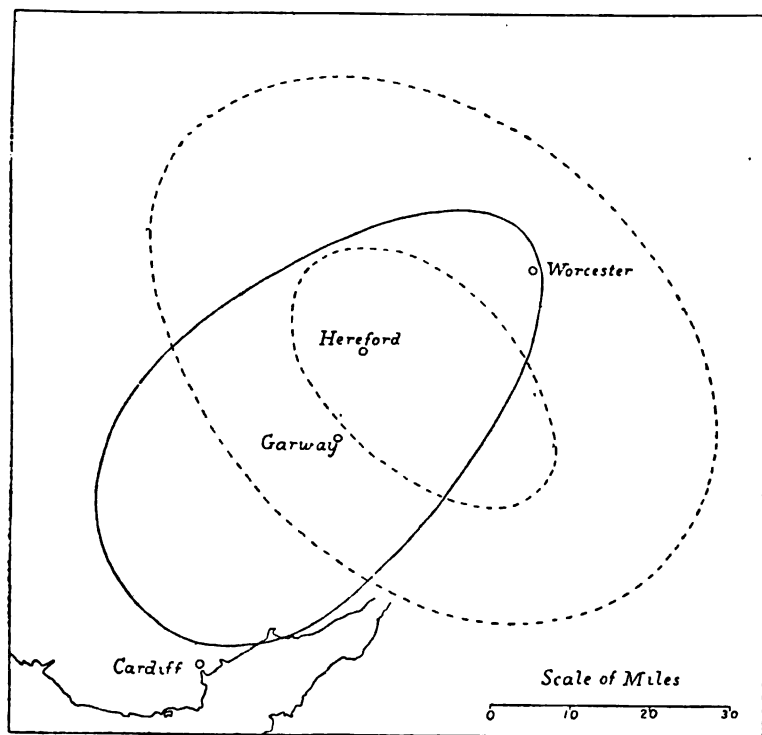


FIG. 21.—Map of Hereford Earthquake of 1868.

marked by Mr. Lowe as the district most strongly shaken by the earthquake of 1863.

Though the epicentral areas of these earthquakes partly coincide with that of the earthquake of 1896, there appears to be no further close connexion between them. If we may rely on the not very complete maps of their disturbed areas, the earthquakes of 1863 and 1868 appear rather to be connected with a fault or faults nearly at right angles to that which gave rise to the earthquake of 1896.

¹ *Meteorological Magazine*, vol. iii. 1868, pp. 153-154.

Origin of the Earthquakes

While the evidence of the isoseismal lines of the principal earthquake enables us to determine the approximate positions of the epicentre and the originating fault, that of the isacoustic lines and the nature of the shock leads, as we have seen, to the following conclusions: (1) That the focus consisted of two detached parts; (2) that the north-west or Hereford focus was about eight miles in length and its central portion below a point about three miles south-east of Hereford; (3) that the south-east or Ross focus was about six miles in length and its central portion below a point two or three miles north-east of Ross; (4) that between these two foci there was an undisturbed portion of the fault about two miles in length; and (5) that the fault-slip at the Hereford focus took place a few seconds before that at the Ross focus.

I have said nothing in preceding chapters about the depth of the seismic focus, for there is in reality no method for its determination on which the least reliance can be placed. If the exact position and hade of the earthquake-fault were known, we might perhaps form a rough conception of the maximum depth of the focus. All that can be said at present is, that the depth of the part from which the principal vibrations proceeded cannot have been greater than a very few miles. It is, I imagine, improbable that this part was more than five miles below the surface; but the distance, measured along the slope of the fault-surface, between the highest and lowest points of the focus may amount to several miles.

How long a time had elapsed since the last sign of growth in the earthquake-fault took place it is impossible to say, but it must be many years in length. During this interval, the stresses tending to produce movement along the fault-surface had been gradually increasing, until they were sufficient to overcome the resistance opposed to them. It is worthy of notice that the earliest perceptible movements were very slight. Their function seems to have been to prepare the way for the great slips to follow by equalising the difference between stress and resistance over a large area of the fault-surface. We cannot trace with accuracy the transference of the seat of movement from one part of the fault to another. The first slip seems to have taken place chiefly in the region between the two foci of the principal earthquake; possibly it overlapped both of them partly. The next three slips were apparently in the neighbourhood of the Ross focus, and were followed by a fifth within nearly the same area as the first. Then came a series of small movements that we cannot locate further than by saying that they were more closely connected with the Ross focus than the other.

In consequence of the preliminary slips within and near the Ross

focus, the effective stress in that portion of the fault was diminished; and this may be the reason why the first great slip took place at the Hereford focus. The immediate result of such a movement would naturally be an increase of stress in and beyond the terminal regions, and the next slip might have been expected in an area partly overlapping the Hereford focus, and either to the north-west or south-east of it. Instead of this, for a distance of two miles in the latter direction there was not the least perceptible movement during the principal earthquake, and the second great slip occurred in the region beyond occupied by the Ross focus.

It is not easy at first sight to account for this interval of no displacement, but the following seems to me to be the explanation, if we may assume that the earthquake-fault throughout the whole length of the focus hades to the north-east.¹ If this be the case, a glance at the geological map (Fig. 20) renders it evident that the earthquake-fault is a reversed fault near the Hereford focus and a normal fault near the Ross focus. Such a form of folding would be a natural result of the movements which are known to have occurred along a north-west and south-east line and producing folds in the perpendicular direction, and of which the earthquakes of 1863 and 1868 were probably incidents. A section of the north-east rock-mass from north-west to south-east and close to the fault, would thus show an anticline at the Hereford focus and a corresponding syncline at the Ross focus, with an undisplaced portion in the intermediate region. Now, if further movements tending to accentuate such a structure were to occur there would be one slip at the Hereford focus, partly to the south-west and partly upwards, and a second at the Ross focus, partly to the north-east and partly downwards; while along the fault-surface between, there would be practically no disturbance. At any rate, the earlier stresses in that region may have been fully relieved by two slight preliminary slips (A and E), and those resulting from the great slips by the first after-shock (J), which succeeded the principal earthquake in about ten minutes.

Half an hour later, another small slip took place at the Ross focus, and, by this, the equilibrium of the rock-mass was almost completely restored; for we have no certain evidence of any further movements until seven months had elapsed, when there was a final slip in about the same region of the fault.

In the preceding pages, I have endeavoured to trace in outline the history of an earthquake-series. In many ways the account is incomplete. If the opportunity were to be renewed, no doubt, with

¹ It is possible that, in the interval between the two foci, the direction of the hade changes, so that in the Ross focus it is towards the south-west. There is nothing in the seismic evidence opposed to such a view, and a similar explanation of the two detached foci would apply in this case.

the experience thus gained, the evidence on some points might be strengthened, and on others, where lacking, might be partially supplied. But the period embraced is too brief to exhibit the connexion of the recent shocks with those which have preceded them or with those which are yet to come. We might, indeed, as well expect to understand the causes and effects of the French Revolution from the study of a single day's proceedings. Nevertheless, if at present they form an apparently isolated series of events, they have thrown some light, I trust, on the nature of the operations which are at work in shaping our island. We learn, at any rate, that the forces which have raised our mountains and helped to produce our diversified scenery are still in action. In comparison with the more rapid rate of change now taking place in Chili and Japan, the earth's crust beneath us may be regarded as almost in a state of rest; in studying British earthquakes, we seem to be watching as it were the last signs of life and movement. But every period of the history requires investigation; and, unattractive as it may appear at first sight, the epoch immediately preceding the death of a fault or mountain-range is at least as interesting to the geologist as the more vigorous periods of origin and growth.

APPENDIX

THE METEOR OF DECEMBER 17, 1896

By a strange coincidence, a bright meteor traversed a large part of the disturbed area almost exactly at the time the earthquake originated, and was observed, either directly or indirectly, by many of those who felt the shock. Over the central counties, and indeed throughout most of England, the air was still and the sky bright, though in places a slight mist prevailed so that only stars of the first magnitude were visible. In the north of Cheshire, in Lancashire, and in north-east Wales, however, the earthquake was preceded and followed by falls of snow and hail, and several flashes of lightning were seen. It is somewhat difficult, therefore, to trace the meteor in the northern part of its course, especially as, farther to the south, its sudden appearance and disappearance led many persons, who only saw the glare, to compare it with a flash of lightning.

It was frequently remarked by those who were indoors that, at the time of the earthquake, there was a bright light, and after the shocks were over it went dark. Some noticed a flash of light on the blind, or a light on the ceiling as from a lantern. One observer stated that his bedroom seemed to be lit up as if by an electric light; another that it was as if a ball of light were in the middle of the room. To those outside it appeared as bright as the brightest sunshine, as so dazzling that it was easy to see for a long distance, or even to pick up a pin from the ground; to a few, in their excitement, as if the very streets were on fire.

The meteor itself was seen by many observers. Mr. E. J. Lowe, F.R.S., informs me that he examined two persons at Bristol: "One was walking in the street, the other was awake and heard the noise before seeing the flash. Both say the flash was white and intense, but unlike lightning. At first, it appeared in the east-south-east, and moved slowly enough for the observers to turn round and notice it slowly disappearing in the north-west. It was intensely bright as seen in the east-south-east, but not so brilliant when in the north-west." At Badgworth (in Gloucestershire) a gentleman "was looking out of his bedroom window in a north-westerly direction at a peculiar rosy appearance in the sky, when a magnificent shower of meteors took place, all [apparently] falling straight down." At Horsehay (in Shropshire) a very brilliant meteor was seen just before the earthquake, "which

seemed to go right down to the ground"; and, at several other places in the same county, the earthquake was preceded by a ball of fire, or two or three balls of fire or luminous flashes, which were seen to traverse the sky from south to north.

It will be obvious, from the accounts quoted above, that the time-relations of the meteor and earthquake varied in different parts of the disturbed area; and this is the most curious feature of the approximate coincidence in time of the two phenomena. There can be no doubt whatever that in the central part of the disturbed area, the meteor passed *after* the earthquake had begun, and possibly after it had ended. Outside this region, it was observed entirely *during* the shock; while still farther from the epicentre, both to the south and the north, the meteor was seen *before* any sign of the earthquake was perceived, so that to some observers the preliminary sound of the earthquake appeared to be the thunder following the imaginary lightning flash. The great velocity of meteors as compared with that of earthquake-waves is well known, but no more conclusive illustration of the fact could be desired.

The observations of the meteor are not exact enough to determine its points of appearance and disappearance. They are sufficient to show, however, that the meteor travelled in a northerly direction, and the form of the area over which it was visible implies that its course was from about S. 10° E. to N. 10° W., passing vertically over Devizes, Malmesbury, Badgworth, Worcester, Kidderminster, Newport (Shropshire), Northwich, to a little west of Longridge (near Preston). The greater width of this area in its southern part is also evidence that the meteor was at a greater height in the south, than in the north, of England.

The area over which the meteor was distinctly visible is 170 miles long (from near Devizes to near Longridge), and its greatest width is 90 miles (from Talgarth, in Breconshire, to Mixbury, in Buckinghamshire); but the glare of the meteor was also seen at Ilfracombe and at Wealdstone (in Middlesex), places which are 165 miles apart, and also near Bulmer (13 miles N.E. of York).

My chief reason for referring to the meteor in this work is, not so much to prove the unsoundness of the inference that the mysterious light observed by many persons had any direct connexion with the earthquake, as to answer a possible suggestion whether any of the sounds accompanying the earthquake may have been due to the bursting of the meteor or to its passage through the air (see also p. 285). I think we may conclude with safety that the meteor was responsible for none of the sounds which accompanied the earthquake. The explosive or crashing sounds were observed in close connexion with the strongest vibrations; and the rushing sounds like wind were nearly always noticed at the same time as the preliminary and subsequent tremors, and frequently changed (without discontinuity) into a deeper rumbling sound accompanying the main part of the shock.

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